



**Remote Access Server  
with V.90 Modems or  
Hybrid ISDN Ports**

**Model RF300E and RF310E**

**User Guide**



## User Guide

S0000066 Revision A

RASFinder Models RF300E and RF310E

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## Chapter 1 - Introduction and Description



## Introduction

Welcome to Multi-Tech's new RASFinder™, Models RF300E and RF310E, Remote Access Servers (RAS) for connecting telecommuters and mobile users to a corporate LAN. Both models provide 56K or ISDN remote server support for dial-out LAN users on IP or IPX networks and LAN security for dial-in connections with user name and password protection and callback security.

The difference between the two models is the ISDN interface, model RF300E has the European and rest of the world (ROW) interface (S/T-Interface), model RF310E has the North America interface (U-Interface).

The RASFinder has three hybrid ISDN ports with six integrated V.90/56K modems for dial-in and dial-out services, an Ethernet 10BaseT connection for local LAN users, and a command port for configuration.

System management is provided through the command port using bundled Windows® based software which provides easy-to-use configuration menus.



Figure 1-1. RASFinder Model RF300E/RF310E

## Preview of this Guide

This guide describes the RASFinder and tells you how to install and configure the unit. The information contained in each chapter is as follows:

### Chapter 1 - Introduction and Description

Chapter 1 describes the new hybrid RASFinder. Descriptions of the front panel indicators and back panel connectors are provided. A list of relevant specifications is provided at the end of the chapter.

### Chapter 2 - Installation

This chapter provides information on unpacking and cabling your RASFinder. The installation procedure describes each cable connection starting with connecting the power cord, Command port, LAN and finally the WAN. The software installation process must be done through the Command port.

### **Chapter 3 - Software Loading and Configuration**

Chapter 3 details the software loading and initial configuration. Initially, the RASFinder software configures the unit for a Remote Access Server (RAS) configuration. If you want to configure the RASFinder for a Lan-to-Lan configuration, you will have to change the Remote Port Setup to a Client or LAN setting. The RASFinder can also be configured to operate in either a RAS application using a Radius server for security services or a RAS application using the proprietary Remote User Data Base Utility for remote user authentication.

### **Chapter 4 - RASFinder Software**

Chapter 4 describes the RASFinder software designed for the Windows® environment. The software contains a number of utilities that allow for downloading updated firmware, creating a proprietary Remote User Data Base, and a terminal emulation utility for configuring the internal modems. Three typical applications are provided to show you how the RASFinder can be configured and some insight into the application.

### **Chapter 5 - Client Setup**

This chapter provides information for enabling and configuring multiple Windows 98/95 or NT® PC users for Internet access via the RASFinder.

### **Chapter 6 - RAS Dial-Out Redirector**

Chapter 6 describes how Multi-Tech's Remote Access Server for Microsoft network users enables them to dial out and fax out through the RASFinder. It provides information on installing and configuring the WINMCSI modem-sharing software.

### **Chapter 7 - Remote Configuration and Management**

This chapter provides procedures for changing the configuration of a remote RASFinder located elsewhere on a LAN or at the other end of a modem connection. This chapter also describes typical Telnet client and Web-browser management of the RASFinder.

### **Chapter 8 - Service, Warranty and Tech Support**

This chapter provides statements concerning the product warranty, provides space for recording information about your RASFinder prior to calling Multi-Tech's Technical Support, and includes instructions for contacting Technical Support and returning your RASFinder to the factory if it requires service. Also included is information on how to obtain product support through the Internet.

## Front Panel

The front panel has four groups of LEDs that provide the status of the LAN connection and link activity. Two other LEDs indicate the general status of the RASFinder. The Ethernet LEDs display the activity of the LAN in whether the RASFinder is connected to the LAN, transmitting or receiving packets, and if a collision is in progress. The Link LEDs display the status of the three links that can be connected to the RASFinder and show whether a link is ready to transmit or receive serial data. The last two LEDs indicate whether the self test passed or failed and if the power ON/OFF switch on the back of the RASFinder is set to ON.

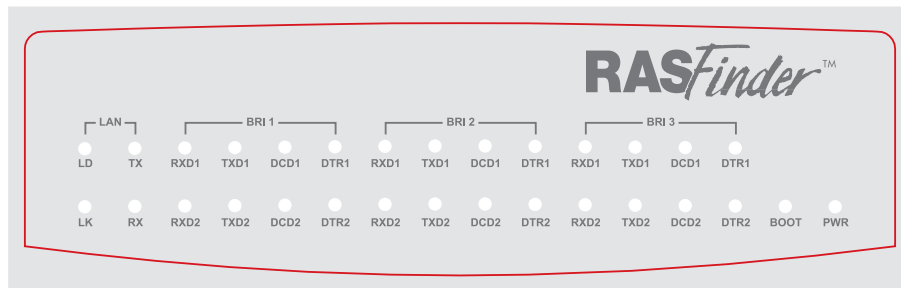


Figure 1-2. Front Panel

### LAN

**LD** TBD.

**TX** Transmit Data indicator blinks when packets are being transmitted to the local area network.

**LK** Link indicator lights indicating that the RASFinder is connected to the local area network.

**RX** Receive Data indicator blinks when packets are being received from the local area network.

### BRI x

**RD** Receive Data indicator blinks when the link is receiving data.

**TD** Transmit Data indicator blinks when the link is transmitting data.

**CD** Carrier Detect indicator lights when the link detects a carrier signal.

**TR** Terminal Ready indicator blinks when the link is ready to transfer data.

**BOOT** The BOOT indicator lights for 3 minutes when power is applied to the RASFinder; if it remains on for over 3 minutes, it indicates that a boot failure has occurred.

**PWR** The power indicator lights when the On/Off switch is in the up (1) position.



## Back Panel

All the cable connections for the RASFinder are made at the back panel. Three groups of cables (all using RJ-45 jacks) are used with the RASFinder: the Command Port, BRI 1 (2 and 3), and the Ethernet. The cable connections are shown in Figure 1-3 then defined below.

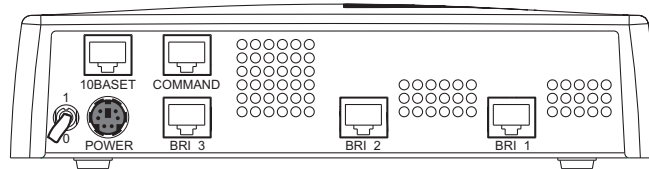


Figure 1-3. Back Panel

### BRI 1 (2 and 3)

Each of these three RJ-45 jacks is used to connect the RASFinder to a WAN.

### Ethernet 10BASET

The Ethernet 10BASET connector is used to connect the RASFinder to a LAN over unshielded twisted pair (UTP) cable. This connector is an RJ-45 jack.

### COMMAND

The COMMAND connector is used to configure the RASFinder using a PC with a serial port and running Windows® software. The Command connector is an RJ-45 jack, and a short adapter cable is provided to convert to a standard serial port DB9 female connector.

### Power Connector

The Power connector is used to connect the external power supply to the RASFinder. The Power connector is a 6-pin circular DIN connector. A separate power cord is connected between the power supply and a live AC grounded outlet.

## Specifications

The RASFinder conforms to the following specifications:

- Routing Protocols - IP and IPX, and bridging for all others
- Ethernet LAN Interface - 10Base-T (twisted pair)
- Three ISDN BRI ports consisting of six V.90/56K modems or six ISDN modems
- Command port - 19.2 Kbps Asynchronous
- 10BaseT Ethernet port
- Two 70-nanosecond 4 MB SIMMs (8 MB, total)  
(RAM is expandable to a maximum of 32 MB)  
**Caution:** SIMM speed and size cannot be mixed.
- 1 MB of Flash memory (on two PROMs)

### Ethernet Port

- One Ethernet Interface - 10Base-T (twisted pair) RJ-45 connector

### Command Port

- Single 56.6K bps asynchronous Command Port using a short RJ-45-to-DB25 cable with a DB25 female connector

### WAN Links

- Six internal V.90/56K modems or six ISDN modems

### Electrical/Physical

- Voltage - 115 VAC (Standard), 240 VAC (Optional)
- Frequency - 47 to 63 Hz
- Power Consumption - 10 Watts
- Dimensions - 2.3" high x 8.4" wide x 6.1" deep  
5.8 cm high x 21.3 cm wide x 15.5 cm deep
- Weight - 1.6 pounds (790g)

### Requirement

- PC with Windows 9X/NT/2000, and one available serial COM port to connect to the Command port of the RASFinder

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\* Though this modem is capable of 56K bps download performance, line impairments, public telephone infrastructure and other external technological factors currently prevent maximum 56 Kbps connections.

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## Chapter 2 - Installation



## Safety Warning Telecom

1. Never install phone wiring during a lightning storm.
2. Never install phone jacks in wet locations unless the jacks are specifically designed for wet locations.
3. This product is to be used with UL and cUL listed computers.
4. Never touch uninsulated phone wires or terminals unless the phone line has been disconnected at the network interface.
5. Use caution when installing or modifying phone lines.
6. Avoid using a phone (other than a cordless type) during an electrical storm. There may be a remote risk of electrical shock from lightning.
7. Do not use the phone to report a gas leak in the vicinity of the leak.

## Unpacking

The shipping box contains the RASFinder, external power supply, cables, your Quick Start Guide, and the RASFinder CD with the RASFinder Software and User Guide in Adobe® Acrobat format. Inspect the contents for signs of any shipping damage. If damage is observed, do not power up the unit; contact Multi-Tech's Technical Support for advice (refer to Chapter 8). If no damage is observed, place the RASFinder in its final location and perform the procedures in the section on Cabling Your RASFinder.

Save the shipping box in case reshipment is necessary.

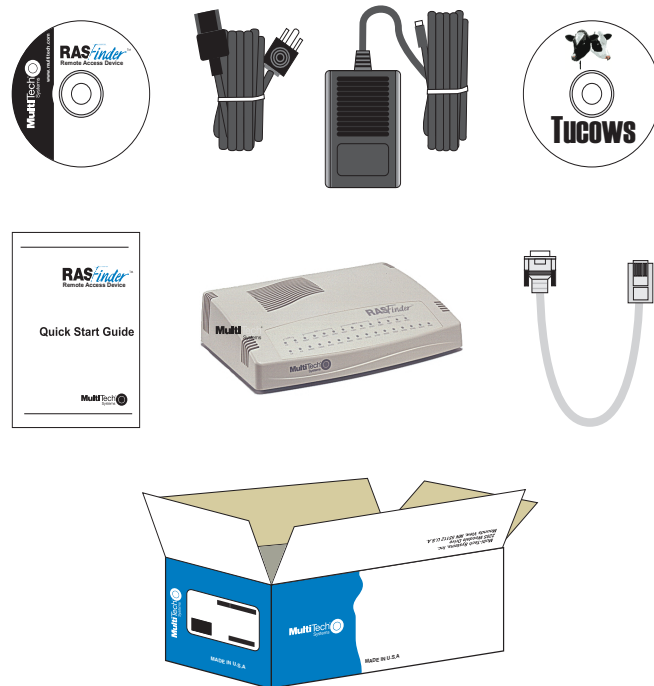
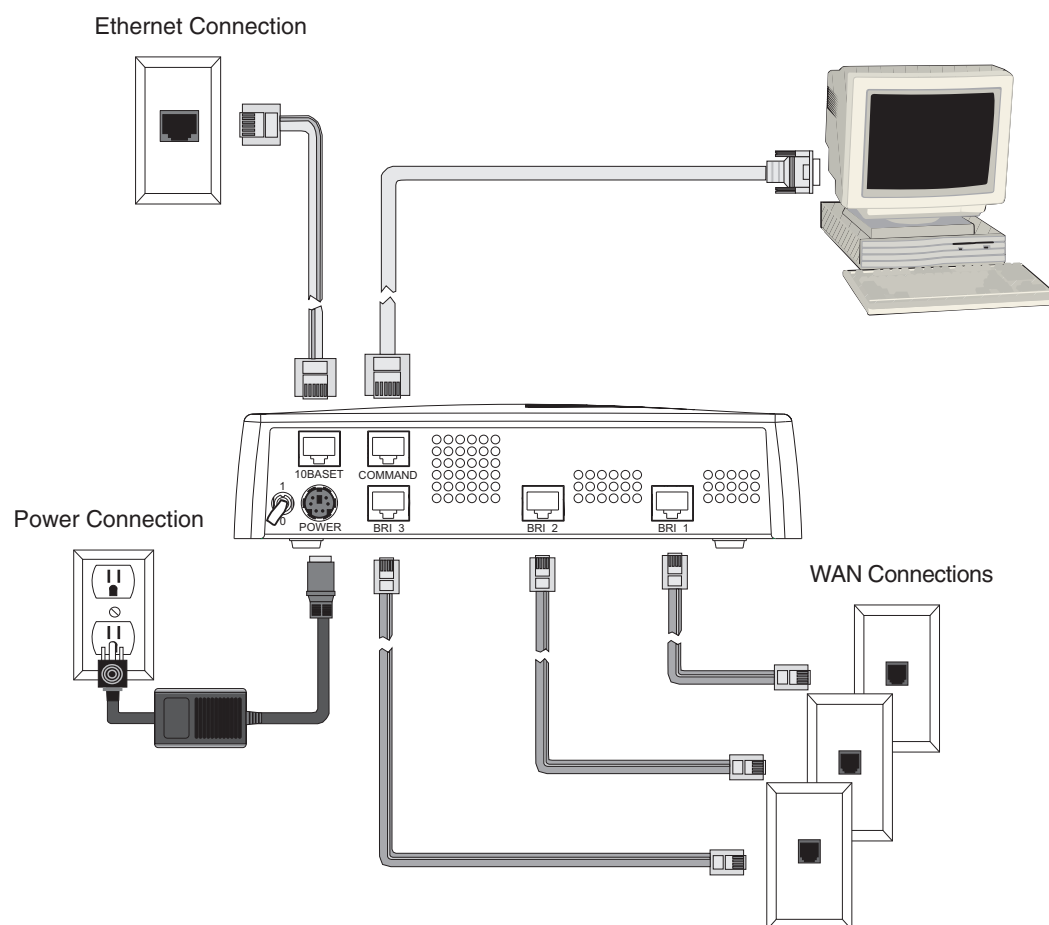


Figure 2-1. Unpacking

## Cabling Your RASFinder

Cabling your RASFinder involves making the proper WAN, Ethernet, Command Port, and Power connections. Figure 2-2 shows the back panel connectors and the associated cable connections. The procedures for connecting the cables to your RASFinder are provided below.



**Figure 2-2. Back Panel Connections**

**Note:** If additional RAM is needed, perform the procedure in the next section, Adding Additional RAM.

The following steps detail the procedures for connecting the cables to your RASFinder.

- 1 Connect the RASFinder to a PC using the short RJ-45 to DB9 (female) cable provided with the unit. Plug the RJ-45 end of the Command cable into the Command Port of the RASFinder and the other end into the PC's serial port. See Figure 2-2.
- 2 Connect an RJ-45 (UTP) cable to the 10 BASE-T connector on the back of the RASFinder. Connect the other end of the cable to your LAN.
- 3 Connect one end of a UTP cable to each of the BRI Connectors on the RASFinder (labeled BRI 1, BRI 2, and BRI 3) and connect the other end to a WAN jack (as shown in Figure 2-2).
- 4 Connect one end of the power supply to a live AC outlet, then connect the other end to the RASFinder as shown in Figure 2-2. The power connector is a 6-pin circular DIN connector.
- 5 Turn on power to the RASFinder by setting the ON/OFF switch on the back panel to the ON position. At this time your RASFinder is completely cabled.

Proceed to the next section to install the RASFinder software.





## Chapter 3 - Software Loading and Configuration



## Introduction

This chapter covers procedures for loading the RASFinder software from a Windows PC (Win98/95 or WinNT) and configuring your RASFinder. Configuration includes setting up the LAN and WAN port IP addresses, setting up the ISDN configuration default parameters, then downloading the default setup to the target ISDN RASFinder.

## Before You Start Loading your Software

Consider the following choices before you configure your RASFinder and record your selections on the following pages; then refer to them while loading your software.

### Network Configuration

✓ **Network Switch Type** \_\_\_\_\_

Select the network switch type your ISDN service provider uses at its local central office. You can set the RASFinder to NET3 (EuroISDN), or 1TR6 (German), AT&T 5ESS, DMS-100, or NI-1. If you do not know the switch type, you can get the information from your ISDN service provider.

✓ **Data TEI** \_\_\_\_\_

The Data TEI (Terminal Endpoint Identifier) is assigned to the data channel. You can select "Auto TEI," a fixed TEI, number (from 0 to 63), or "Disabled." A TEI is a number used by the central office switch to uniquely identify each device that is connected to the network. When it uses dynamic TEI assignments (Auto TEI), the central office switch assigns a TEI each time the RASFinder connects to the network. However, the ISDN service provider may assign a fixed TEI at subscription time, in which case you must configure the RASFinder with the fixed TEI number. You can also disable the channel, which may be useful when multiple RASFinders are attached to a network terminator bus.

✓ **Voice TEI** \_\_\_\_\_

The Voice TEI is the TEI assigned to the voice channel. You have the same choices as for the Voice TEI: "Auto TEI," a fixed TEI number (from 0 to 63), or "Disabled."

✓ **Data SPID** \_\_\_\_\_

The RASFinder must be configured with the Service Profile Identifier (SPID). The data SPID is assigned by the local phone company and is for the specific Basic Rate Interface (BRI) line to which the RASFinder will be attached. The data SPID string can have up to 20 characters. The data SPID is not used if the switch type is set to NET3.

**Note:** For DMS-100 switches, any ASCII character except the underline ( \_ ) character is valid. For NI-1 and AT&T switches, only the digits 0-9 are valid.

✓ **Voice SPID** \_\_\_\_\_

The voice SPID is assigned by the local phone company and is for the specific BRI line to which the RASFinder will be attached. The voice SPID string can have up to 20 characters. The data SPID is not used if the switch type is set to NET3.

**Note:** For DMS-100 switches, any ASCII character except the underline ( \_ ) character is valid. For NI-1 and AT&T switches, only the digits 0-9 are valid.

✓ **Data Directory Number** \_\_\_\_\_

The data Directory Number (DN) is a telephone number that is assigned to the RASFinder at subscription time by the ISDN service provider. The DN is a string of up to 24 characters; valid characters are 0-9, the \* character, and the # character.

✓ **Voice Directory Number** \_\_\_\_\_

The voice Directory Number (DN) is a telephone number that is assigned to the RASFinder at subscription time by the ISDN service provider. The DN is a string of up to 24 characters; valid characters are 0-9, the \* character, and the # character.



## Call Control Parameters

### ✓ Persistent DTR Dialing

A high DTR (Data Terminal Ready) signal on the Command port indicates that your computer or terminal is ready to communicate with your RASFinder. DTR normally goes high when a communication program starts or is ready to dial. Persistent DTR dialing enables the RASFinder to automatically redial the number stored in memory location 0 whenever DTR is high and the serial port does not have an active call. You may enable or disable this feature.

### ✓ Calling Line Identification

Identifies whether the two endpoints of a connection are enabled or disabled. Since RING messages only appear for ISDN data calls, the CLI feature does not define a means of conveying Calling Party information to the terminal for ISDN voice calls. The CLI information is only included with the first RING message for a given incoming call and appears as follows:

RING

FM: 5552000 TO: 5551000

If the Calling Party Number information is not included in the incoming SETUP message, the RING message appears as follows:

RING

TO: 5551000

If the Called Party Number information is not included in the incoming SETUP message, the RING message will appear as follows:

RING

FM: 5552000

If neither the Called Party Number, nor the Calling Party Number is included in the incoming SETUP message, the RING message will contain no additional information.

### ✓ Auto Protocol Detection -

Identifies that automatic protocol detection is enabled or disabled for an ISDN data call. The default setting is 1, which enables the Auto-Protocol Detection function.

### ✓ Auto Answer Data Calls \_\_\_\_\_ Rings to Answer\_\_\_\_\_

Select Auto Answer if you want your RASFinder to automatically answer all incoming data calls (this option does not affect the analog port). The Rings to Answer number, in the range of 1 to 255, selects the number of rings the RASFinder waits before answering an incoming call. The default is one ring.

## Data Control

### ✓ Data Protocol \_\_\_\_\_

The data protocol, also known as the B-channel protocol and the rate adaption protocol, is the "language" that is spoken over each 64 Kbps channel between two ISDN devices. The devices on both ends of the ISDN link must use identical data protocols.

### ✓ Dialing Method \_\_\_\_\_

Select either the "Enbloc" or the "Overlap" dialing method for use when establishing a data call. Your ISDN service provider determines the dialing method. The en bloc method is used for most ISDN dialing; however, you can select the overlap method if you are working with a private network.

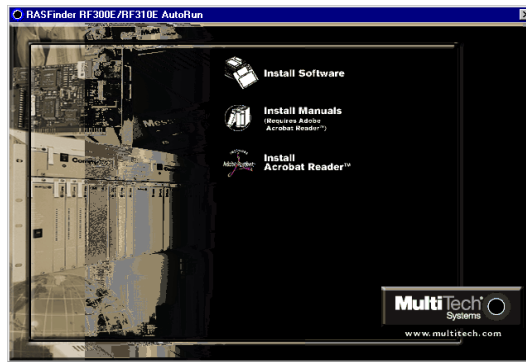
# Installing Your RASFinder Software

The default application of the RASFinder is as a Remote Access Server equipped with a database of remote users for dialing into their corporate LAN. The RASFinder can also be configured to serve as a LAN-to-LAN router; however, this requires additional setup through the main menu after completion of the basic software installation process.

**Note:** If you are configuring your RASFinder and loading software for North America (US Parameters), be sure you have Model RF310E (U-Interface).

If you are configuring your RASFinder and loading software for European Parameters or Rest of World (ROW), be sure you have Model RF300E (S/T-Interface).

1. Insert the RASFinder CD-ROM into the CD-ROM drive on your local PC. The CD-ROM should start automatically; however, it may take 10 to 20 seconds for the Multi-Tech RASFinder Autorun screen to appear.



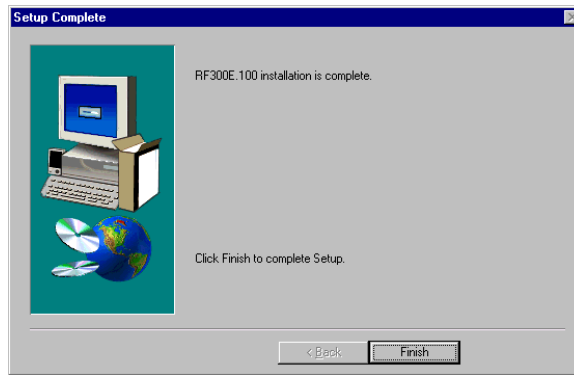
2. If the Multi-Tech Installation CD Screen does not appear automatically, click **My Computer**, then right-click the **CD-ROM drive** icon and click **Autorun**.
3. When the Multi-Tech Installation CD Screen appears, click the **Install Software** icon.
4. The **Welcome** screen is displayed.



Press **Enter** or click **Next>** to continue.

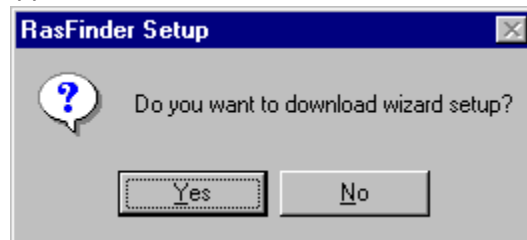


- The software is loaded onto your pc, then the **Setup Complete** dialog box is displayed.

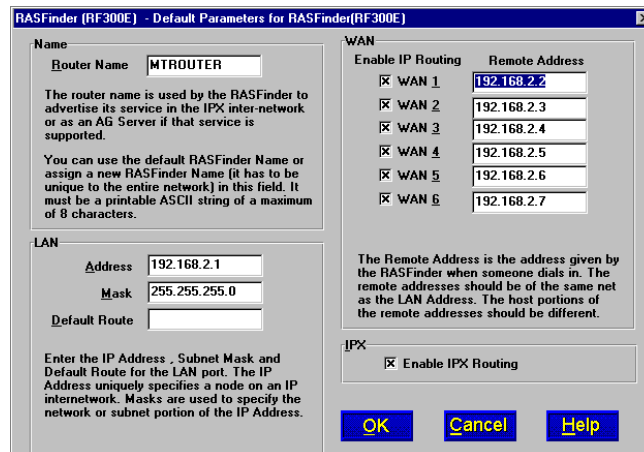


Click **Finish** to continue.

- The following message appears:



- Click **Yes** to download wizard setup. Clicking **No** prevents you from setting up the defaults and downloading them to the RASFinder; instead, you are returned to the program group.
- The **Default Parameters** dialog box appears. This dialog box enables you to assign the router name (required for IPX routing), establish the IP address, mask, and default route for the LAN port, enable or disable IPX routing, set up the remote addresses for the WAN ports, and disable any WAN ports not used.



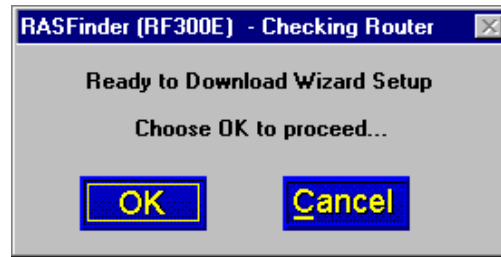
**Router Name:** If this is the only RASFinder on your network, you can use the default Router Name (MTROUTER); otherwise, you must assign a new Router Name in this field. The Router Name can be any printable ASCII string of up to 8 characters. The RASFinder will use this name to advertise its service in the IPX internetwork.

The default **LAN IP Address** has to be changed to your unique LAN port address. In the LAN group, change the default **Address** to the value assigned to your LAN port. When you change the **LAN Address**, the **remote WAN addresses** also change to the same network and in sequential order.

Change the default **Mask** to the value assigned to your LAN port.

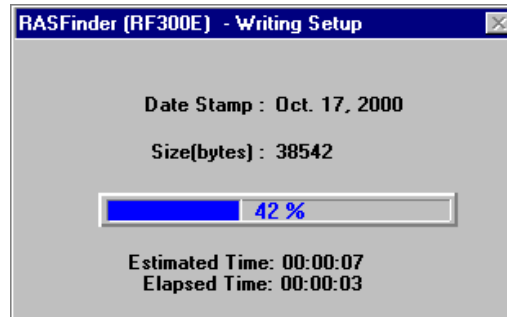
If you established a **Default Route** on your LAN, enter the address of the route.

12 The following message is displayed.

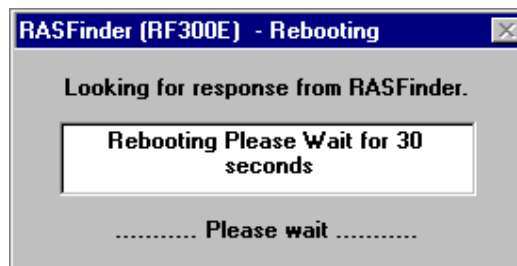


Click **OK** to proceed.

13 The **Writing Setup** dialog box (with the current date and the file size in bytes) is displayed as the setup configuration is written to the RASFinder.



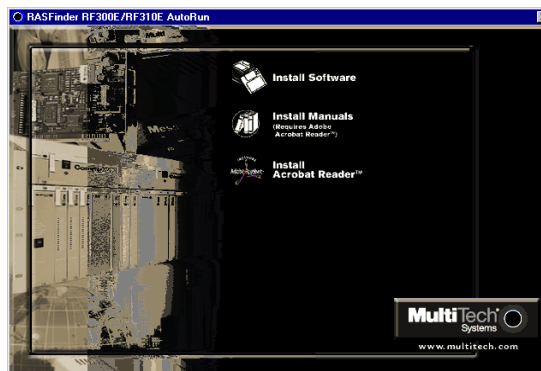
14 Next, the **Rebooting** dialog box is displayed.



15 Check to ensure that the **BOOT LED** on the RASFinder goes Off after the download is complete and the RASFinder is rebooted (the **Rebooting** dialog box goes away). This may take several minutes as the RASFinder reboots.

16 You are returned to the Multi-Tech RASFinder Autorun screen where you can now install (on your PC's hard drive) either Acrobat Reader (by clicking the **Acrobat Reader** icon) or the User Guide.

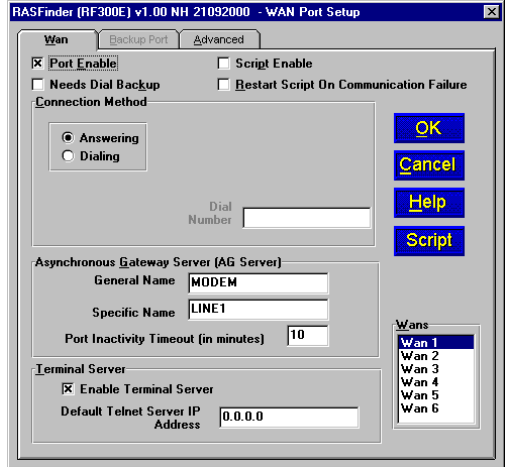
To install the User Guide, click the **Install Manuals** icon, then click **OK** and the files will install at **C:\Program Files\Multi-Tech Systems, Inc.\RF300E\Documentation** unless you browse and select an alternate directory for installation.



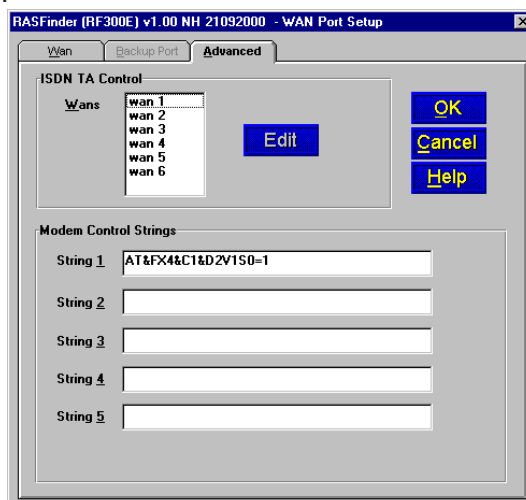
- 17 If you need to enter ISDN parameters, proceed to step 18.  
If you want at this time to set up your RASFinder as a RAS with the Proprietary user database, proceed to Setting Up Your Remote User Database section in this Quick Start Guide.  
If you want at this time to set your RASFinder so that a Radius server provides your user database, proceed to Setting Up RADIUS.  
If you want at this time to set up your RASFinder for LAN-to-LAN routing, proceed to the Final Routing Setup section.
- 18 If you need to enter specific ISDN parameters (SPIDs) and DNs for North America, or data and voice ISDNs and subaddresses for European Parameters, click **Start | Programs | RF300E 1.00 | RASFinder Configuration**, or double-click the **RASFinder Configuration** icon in the **RF300E 1.00** icon group window when it is displayed on your desktop. The main menu (**Router Setup**) is displayed.



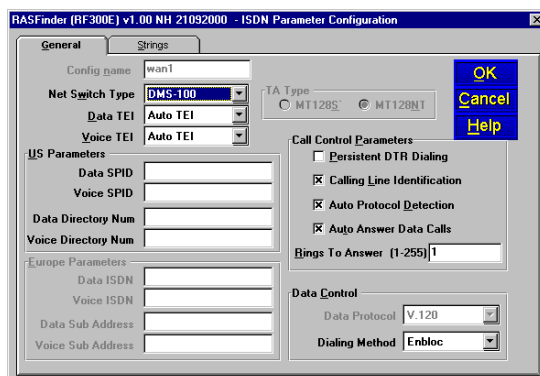
- 19 From the Main menu, click the **WAN** button. The WAN Port Setup screen is displayed.



- 20 Click the **Advanced** tab.



- 21 Select (highlight) the WAN port you want to configure, then click **Edit**. The ISDN Parameter Configuration dialog box is displayed with the **Config name** window displaying the WAN port you just selected.



- 22 Click the down arrow for **Net Switch Type** and highlight the switch type used by your Telco. If necessary, refer to your **Network Switch Type** entry in Before You Start Loading your Software. The default is **NET3** (for EuroISDN). Available selections for the USA are: **AT&T 5ESS**, **DMS-100**, and **NI-1**. **VN4** is for France, **ITR6** is for Germany, and **INS64** is for ISDN BRI (Japanese).
- 23 Click the **Data TEI** field on the **General** tab. Refer to your Data TEI entry in the Network Configuration section in Before You Start Loading Your Software. If the **Data TEI** is different, click the drop-down list arrow and click the selection that corresponds to the Data TEI (i.e., Disabled, Auto TEI, or zero to 63) supplied by your Internet service.
- 24 Click the **Voice TEI** field on the **General** tab. Refer to your Voice TEI entry in the Network Configuration section in Before You Start Loading Your Software. If the **Voice TEI** is different, click the drop-down list arrow and click the selection that corresponds to the Voice TEI (i.e., Disabled, Auto TEI, or zero to 63) supplied by your Internet service.
- 25 Depending on the switch type chosen above, either the **US Parameters** group or the **Europe Parameters** group will be activated.

If the **US Parameters** group is activated you may have to enter the SPID and Directory number(s) associated with the WAN port in the Config name window.

A SPID (Service Profile Identifier) is a number that is supplied to you by your local phone company which encompasses the phone number.

A Data or Voice Directory Number (DN) is the phone number assigned to that B-Channel for the BRI line provisioned by your phone company. If a DN is assigned, then only the device associated with that WAN port will respond to the call.

**CAUTION:** WANs 1 and 2 correspond to BRI 1. B-Channel 1 of BRI 1 corresponds to WAN 1, and B-Channel 2 of BRI 1 corresponds to WAN 2. The BRI line from the Telco has to be connected to the corresponding port on the RASFinder (e.g., BRI Line 1 has to be connected to BRI 1 port on the back of the RASFinder. The SPID and Directory Number (if used) for the BRI line assigned by the Telco have to be entered on the ISDN Parameter Configuration dialog box for the corresponding WAN number. WANs 1 and 2 are associated with BRI Line 1 and BRI 1 port on the back of the RASFinder. Each of these entries has to correspond to the way the Telco provisioned the line, or else calls will not go through.

If the chosen switch type activates the **Europe Parameters** group, you may have to enter Data/Voice ISDN and Sub Addresses associated with the WAN port displayed in the Config name window.

Enter the Data/Voice ISDN associated with the WAN port displayed in the Config name window.

The Data and Voice ISDN numbers can be up to 20 characters in length. The Data/Voice ISDNs are assigned by your local phone company for the specific BRI line attached to the RASFinder. The BRI line has to correspond to the BRI port on the back of the RASFinder and the B channel of that line has to correspond to the WAN Port number; e.g., BRI Line 1 B-Channel 1 corresponds to WAN 1 and BRI Line 1 B-Channel 2 corresponds to WAN 2.

- 26 When you have finished entering the Parameter information for your WAN port, click **OK** and you are returned to the **WAN Port Setup** dialog box; the ISDN TA Control group and the WAN number you just configured will be highlighted.
- 27 Highlight the next WAN port you want to configure, then click **Edit**. Repeat steps 22 and 26 for each WAN port you need to configure.
- 28 When all the necessary WAN ports are configured, click **OK** twice to return to the Main menu.
- 29 At this time your RASFinder is operational.

If you want to assemble your Remote User Database, proceed to the next section.

If you want to setup your Radius, proceed to Setting Up RADIUS section.

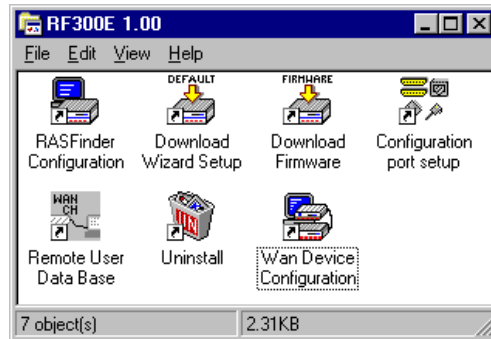
If you are setting up your RASFinder for routing, proceed to the Final Routing Setup section.



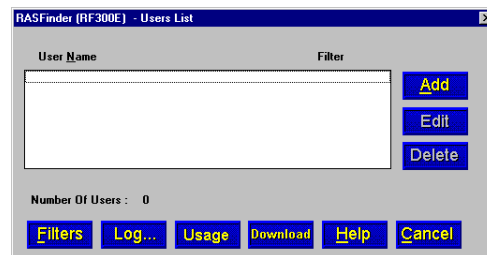
## Setting Up Your Remote User Database

The proprietary Remote User Data Base supports remote dial-in users for user name, password, and port availability. Each dial-in user needs an entry in this database. You can add remote users, remove users, or edit information in the database.

- 1 From your desktop, click **Start | Programs | RF300E 1.00 | Remote User Data Base**, or double-click the **Remote User Data Base** icon in the **RF300E 1.00** icon group window (below).



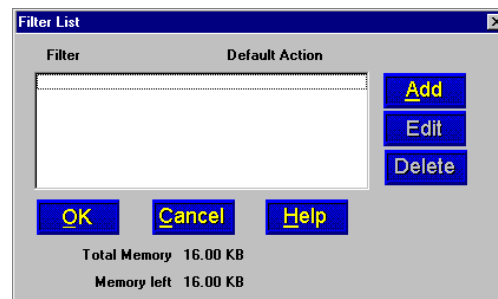
- 2 An **Accounting Info - Read** screen appears briefly, then the **Users List** dialog box is displayed.



### Filters

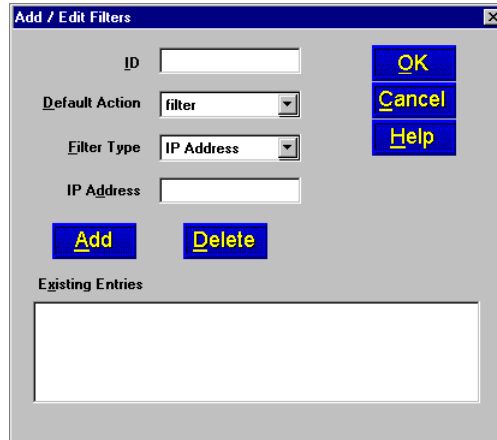
Part of the database is the type of filtering that is applied to each user (e.g., filtering on an IP address or filtering on a specific protocol). These filtering conditions are established by clicking the **Filters** button.

- 3 Click **Filters** to establish the filtering parameters for the remote user entry. the **Filters List** dialog box is displayed.



Click the **Add** button.

- 4 The **Add/Edit Filters** dialog box is displayed.



- 5 Build your filtering parameters by filling in the following fields for each remote user.

**ID**

This field requires a unique filtering identification characterizing the type of filtering used. The ID can be up to 9 alphanumeric characters in length; examples are: Type 1, Server 1, Setup 1, etc.

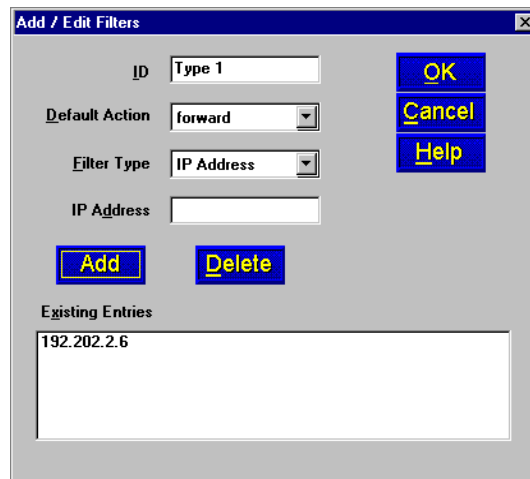
**Default Action**

This drop-down list enables you to select either **filter** or **forward**. If you select filter, then the entry will be transmitted with filtering properties. If you select forward, you will still have to select a filter type, etc.; however, the entry will be transmitted without filtering properties. The default setting is filter.

**Filter Type**

The Filter Type drop-down list enables you to select the filter type. The filter types are either IP Address, Protocol, or Domain Name. The default setting for Filter Type is IP Address.

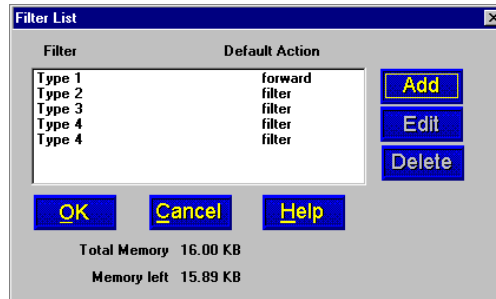
- **IP Address** – If the filter type is IP Address, enter the IP Address of the remote user in dotted-decimal format, then click the **Add** button to move it to the **Existing Entries** text box at the bottom of this dialog box.



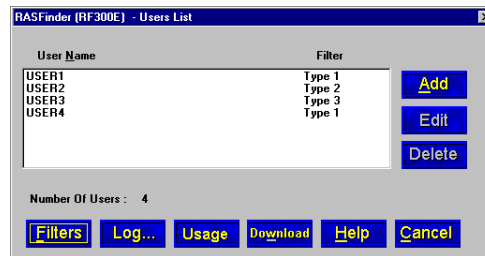
- **Protocol** – If you select Protocol as the filter type, the **IP Address** text box changes to **Protocol** and **Port** drop-down list fields. Select either TCP or UDP from the Protocol drop-down list and select either Telnet, FTP, or SFTP from the Port drop-down list, then click the **Add** button to move these selections to the **Existing Entries** text box at the bottom of this dialog box.
- **Domain Name** – If you select Domain Name as the filter type, the **IP Address** text box changes to a **Domain Name** field. Enter the domain name consisting of a sequence of names separated by periods (dots) followed by an extension; e.g., "pictures.computers.com." Click the **Add** button to move the domain name to the **Existing Entries** text box at the

bottom of this dialog box. The domain name can be up to 39 alphanumeric characters including periods.

Click **OK** to add the current entry to the **Filters List** dialog box, then repeat step 5 until all necessary Filter IDs are defined.



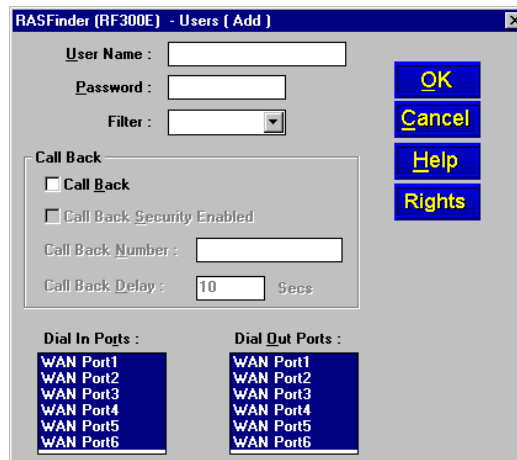
- 6 When done, click **OK** again to return to the **Users List** dialog box, then click **Download** to save the filter entries to the RASFinder.



While still at the **Users List** dialog box, click **Add**.

## Build User Database

- 7 The **Add Users** dialog box is displayed.



- 8 Build your user database by filling in the following fields for each user.

### User Name

The User Name can have as many as 39 characters. All printable characters are permitted with the restriction that no blanks are allowed in the user name. In dial-in and dial-out applications, the user name is treated as a case insensitive string.

### User Password

The User Password can have as many as 7 characters. In places where the password is used as a character string, it is treated as a case insensitive string. Elsewhere (PPPs CHAP), it is treated as a

case sensitive pattern.

**Filter**

The drop-down list enables you to select a unique filter entry that was already defined in the ID field in the **Add/Edit Filters** dialog box.

**Call Back**

Click this check box to enable the Call Back function. If the user is at a number where he wants to be called, he can choose the specific number for call back. For this to work, the Call Back option must be enabled (activated) and the Call Back Security Enabled option must NOT be enabled (activated). The remote user would then use a standard PPP client or ASCII terminal to dial-in.

To enable Call Back Security, you must enable (check) the Call Back option and and fill in the following three boxes/fields.

• **Call Back Security Enabled**

This parameter is of use in dial-in applications where the user is always called back at a specific number. Enabling this parameter (Alt-S) lets the administrator assign the call back parameters. Leave this function disabled if the user is permitted to choose the call back number and the call back delay.

• **Call Back Number**

The Call Back Number is editable only if Call Back Security is enabled (checked). This is the number where the user will be called back. In this case, the user **cannot** choose the number where he wants to be called back.

**Note:** You can enter the Call Back Number with or without dashes, the modem will ignore them if they are present.

• **Call Back Delay**

Call Back Delay is editable only if Call Back Security is enabled. This specifies the duration (in seconds) after which the user will be called back at the administrator-assigned number.

**Dial In Ports**

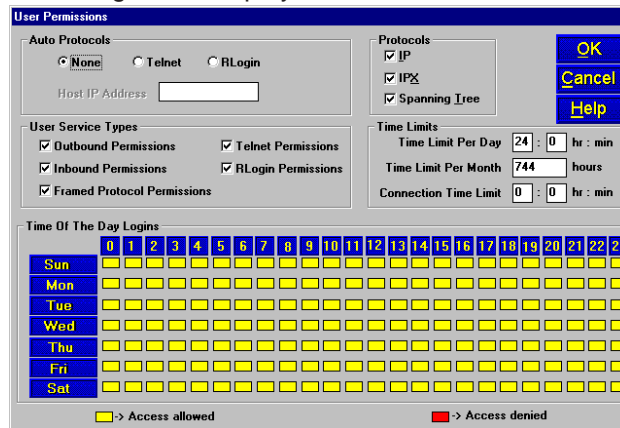
The systems administrator can enable (highlight) any WAN Ports 1 through 6 to be made available for dialing in to the RASFinder.

**Dial Out Ports**

The systems administrator can enable (highlight) WAN Ports 1 through 6 to be made available for dialing out from the RASFinder.

Click the **Rights** button to assign user permissions for the remote user.

- 9 The **User Permissions** dialog box is displayed.



- 10 Build your user permissions database by filling in the following fields for each remote user.

**Auto Protocols**

This group enables the systems administrator to assign either unrestricted LAN/Intranet access or limited protocol access. The three available options are:

- **None**

This option (the default setting) gives the user unrestricted access to the LAN/Intranet.

- **Telnet**

This option allows Telnet sessions between the designated server (defined in the **Host IP Address** field) and the remote user. Telnet is an applications-level protocol commonly found in IP-based networks that allows terminal emulation at a remote workstation. If you select Telnet, you must enter an IP address in the Host IP Address field. This limits the user to only specific functions on the network.

- **RLogin**

This option allows the RASFinder to be used as an RLogin client for connecting to an RLogin Server (defined in the **Host IP Address** field). RLogin is an application protocol that provides a terminal interface between Unix hosts using TCP/IP network protocol. Unlike Telnet, RLogin assumes that the remote host is a Unix machine. If you select RLogin, you must also enter an IP address in the **Host IP Address** field. This limits the user to only specific functions on the network.

### Host IP Address

Enter the IP Address for the Telnet or RLogin host computer (server). The Host IP Address must be in dotted-decimal notation format.

**Note:** This field is enabled (activated) only when either Telnet or RLogin is enabled.

### Protocols

The Protocols group enables you to limit the remote user to IP routing, IPX routing, or bridging (Spanning Tree); or, a combination of any two or all three routing protocols. The default setting is for all three protocols enabled.

### User Service Types

The User Service Types group enables you to set the permissions for the entry being configured. The systems administrator can enable or disable the following options to customize the types of services for a particular remote user. By default, all permissions are enabled. To deny permissions to the entry being configured, click (check) the box to the left of the permission to disable the feature.

- **Outbound Permissions** - grants dial-out rights to remote user.
- **Inbound Permissions** - grants dial-in rights to user.
- **Framed Protocol Permissions** - grants the remote user framed protocol rights (e.g., Framed Protocol – PPP). By enabling (checking) this option, the user becomes an unrestricted user (i.e., both framed and unframed protocols are allowed).
- **Telnet Permissions** - grants the remote user Telnet file transfer rights.
- **RLogin Permissions** - grants the remote user RLogin server connection rights.

### Time Limits

The Time Limits group enables the systems administrator to impose various types of time-related restrictions on the user account.

### Time of the Day Logins

The User Permission grid enables the administrator to deny a remote user Internet access at certain times during the week. This would be applicable when the administrator wants to bring a system down for a particular reason and doesn't want users to access the Internet at that time.

By default, all time periods are color-filled with yellow indicating that the remote user has permission to access the Internet all the time. To deny permission for certain periods of time, click all applicable yellow boxes over the target time range to toggle them to red (Access Denied).

- 11 Click **Add User** to continue adding users to your database.
- 12 After each user is defined in the **Add Users** dialog box and all the user permissions (Rights) are configured, click **OK** to display the updated **Users List** dialog box.
- 13 Click **Download** to write the database to the RASFinder.

## Setting Up Remote Access Dial In User Server (RADIUS)

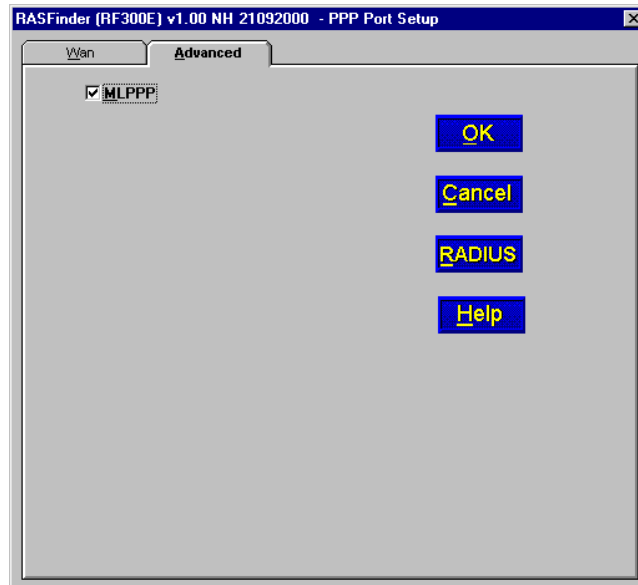
RADIUS is an optional security feature that uses a single authentication server to centralize security on networks with large modem pools, especially those with multiple communication servers.

1. From your desktop, click **Start | Programs | RASFinder 3.10 | RASFinder Configuration**, or double-click the **RASFinder Configuration** icon in the **RASFinder 3.10** icon group window when it is displayed on your desktop.
2. The main menu (**Router Setup**) is displayed.



Click **PPP / SLIP** to continue.

3. The **PPP Port Setup** dialog box is displayed; click the **Advanced** tab.



Click **RADIUS** to continue.

4. The **Radius Setup** dialog box is displayed.

5. Click **RADIUS Enable** to enable Radius security services for all ports on this RASFinder.
6. Click **Accounting Enable** if you want Radius to track accounting information such as login and logout times, bytes sent and received, etc.
7. Leave **Allow Call if Security Server Down** unchecked (disabled) to prevent users from logging in if the security servers are down.
8. Click **Assign Remote Address Using RADIUS** to enable the Radius Server to automatically assign the IP Address of the WAN port on the RASFinder that the user will dial into.
9. Obtain the **Shared Secret** from the Radius network administrator. The Shared Secret must be the same secret that is used on the Radius server whose address is being supplied for the Radius primary server address entry.
10. Obtain the Radius server address from the Radius network administrator that will provide the security to the RASFinder. The Radius server address is to be entered in the **RADIUS Primary Server Address** field.
11. If additional servers are being used as backup servers, obtain their address(es) from the Radius network administrator and enter them in Backup Servers group. The first backup server address is entered in the **Backup Server Address 1** field. Any additional backup server addresses are to be entered in the **Backup Server Address 2** and **Backup Server Address 3** fields.
12. A set of default attribute values will be displayed in the **Attribute Values** group. These default values are used with the Multi-Tech Radius Server. You do **not** have to change these values if your RASFinder is communicating with Multi-Tech's Radius Server. If you are using another vendor's Radius Server to communicate with your RASFinder, you will have to communicate with your Radius Server network administrator to see how he/she has set up these attribute values and then change the default values to the values being used by that Radius server.
13. Click **OK** when you are finished.

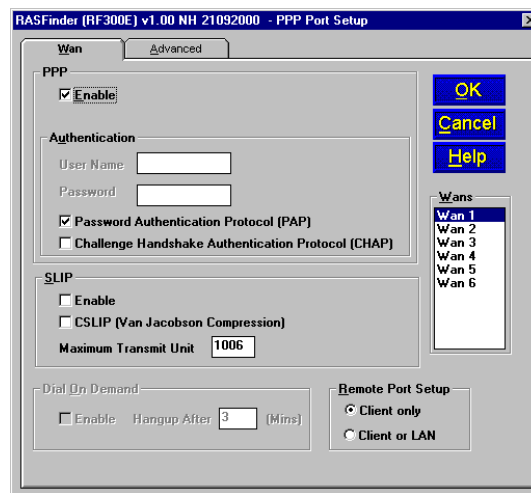
## Final Routing Setup

1. From your desktop, click **Start | Programs | RASFinder 3.10 | RASFinder Configuration**, or double-click the **RASFinder Configuration** icon in the **RASFinder 3.10** icon group window when it is displayed on your desktop.
2. The main menu (**Router Setup**) is displayed.



Click **PPP/SLIP** button to continue.

3. The **PPP Port Setup** dialog box is displayed.



On the **WAN** tab, click **Client or LAN** in the **Remote Port Setup** group in the bottom right corner; this enables **Client or LAN** and disables the default, **Client only**. Select another WAN port you are using and repeat until ALL the WAN ports are switched to Client or LAN.

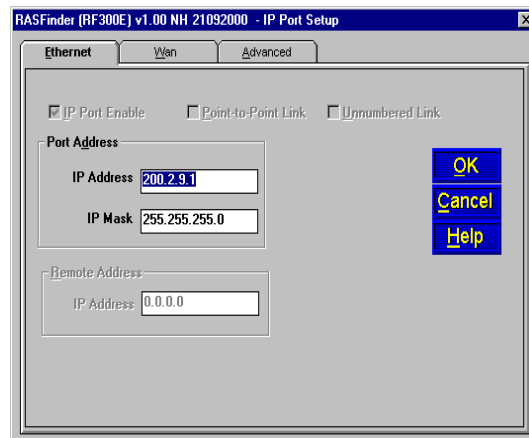


- If you are going to combine the two WAN ports together, i.e., a single IP address, you need to enable the **MLPPP** option from the **Advanced** tab.



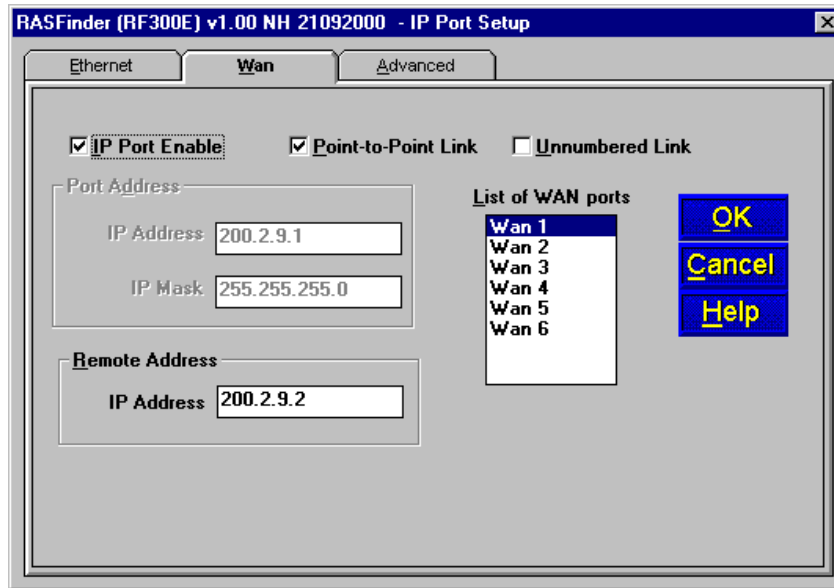
**Note:** When the dialog box “When a PPP port is Client-or-LAN type:” appears, click on the **OK** button each time the dialog box appears. You are returned to the Main menu.

- From the Main menu, click on the **IP** button and the **IP Port Setup** dialog box appears with the **Ethernet** tab active and the Port Address displaying your LAN IP Address.



Click on the **WAN** tab

- On the WAN 1 tab, change the **Port Address** and **Remote Address** groups to be on separate networks from the Ethernet LAN port.



If you enabled MLPPP option on the PPP Port Setup dialog box, the IP addresses for all three WAN ports have to be identical and the remote WAN port addresses have to be within the same network and identical.

If you did not enable MLPPP option, the WAN port addresses have to be on a different network from the LAN port address and have to be different from each other.

- Click on each of the WAN tabs and change the **Port Address** group and **Remote Address** group to conform with the settings for WAN 1.
- Click **OK** to return to the Main menu.



- From the Main menu, click **Download Setup** button to write your new configuration to the RASFinder. After your configuration is written to the RASFinder, you are returned to the Main menu. Your RASFinder is now configured for LAN-to-LAN routing.



## Chapter 4 - RASFinder Software



## Introduction

This chapter describes the RASFinder software and explains how to make changes to the configuration of your RASFinder. The major configuration parameters were established during the loading of the software (Chapter 3). The RASFinder software and configuration utilities allow you to make changes to that initial configuration.

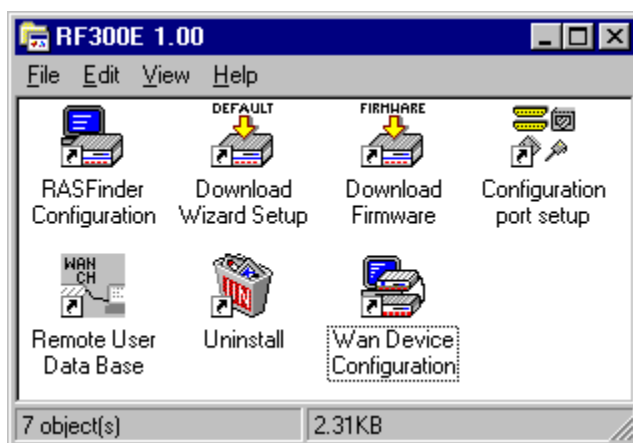
The RASFinder software allows you to refine your configuration based on your network connections. The software is based on a main menu (RASFinder Setup) that allows you to consider all the parameters for a particular feature (e.g., IP or IPX protocol, Bridging, or setting up a WAN port for PPP or SLIP protocol). These features, along with others are discussed in detail in the RASFinder Configuration section later in this chapter.

The other five configuration utilities offer additional functionality. The **Download Wizard Setup** guides you through the initial configuration and software downloading, as described in Chapter 3. **Download Firmware** allows you to download new versions of firmware when enhancements become available. The **Configuration Port Setup** utility allows you to change the method by which you access the RASFinder (i.e., direct connection of a PC to the Command Port on the RASFinder, or via your LAN port on the RASFinder). The **Uninstall RASFinder Configuration** utility is designed to remove the software from your PC. The **WAN Device Configuration** utility opens the Print Console, a terminal emulation program that enables you to configure the built-in modems. The **Remote User Data Base** utility (supported through the command port) allows you to establish and maintain a database of information about your remote users. You can add and remove remote users, or edit existing user information in the database.

Your RASFinder software includes the RASFinder on-line Help system. The Help is designed to be context sensitive. Clicking the Help button within a given dialog will provide definitions and recommended values for each button, option, and field for that dialog. In some instances, you will also be presented with a list of related topics that can be displayed by clicking the green, underlined text. In addition, you can search the entire Help system (via the Index tab) for definitions and references to specific terms, fields, and recommended values where applicable.

## Before You Begin

The RASFinder software operates in a Microsoft Windows® environment. Your RASFinder **RF300E 1.00** program group, with all the utilities described above, is accessible by clicking **Start | Programs | RF300E 1.00 | (utility)**, or by double-clicking the utility icon in the program group in **My Computer (C:\Windows\Start Menu\Programs\RF300E 1.00)**. The program group is shown here:



## Router Configuration

All changes to your RASFinder configuration are initiated through the Router Setup menu. The **Router Setup** menu consists of 13 buttons that enable you to display and change the protocol stacks, define the output of the RASFinder, perform network management functions, test the communications link, print messages received from the target RASFinder, and download setup information to the RASFinder.



The two outer buttons in the bottom row are used to open the on-line Help system (RASFinder Setup Help) and end (Exit) a Router Setup session. The middle (Retry) button remains inactive until you fail to connect to the target RASFinder.

# Typical Applications

The two basic applications for the RASFinder are (1) as a Remote Access Server (RAS) to permit remote users to dial into a local area network and use the resources of that network and (2) as a Router for LAN-to-LAN routing. The RASFinder defaults to a RAS configuration during the initial software loading. Typical examples of both types of applications are presented in the following paragraphs.

## RAS Applications

During the initial software installation, the RASFinder defaults to a remote access server (RAS) configuration. For example, the WAN Ports are connected to individual phone lines and the ports are then configured to answer incoming calls from remote locations. Two methods of identifying remote users are provided in the RASFinder; 1) Remote Access Dial In User Server (RADIUS) and 2) a Remote User Data Base utility in the RASFinder software. Finally, before the application is completely configured, the ISDN parameters have to be established for remote users can dial into the network.

### RAS Application Using Radius

RADIUS is associated with a Radius server on the network which provides a security feature using a single authentication server to centralize security on a network. The Remote User Data Base utility identifies each user by user name, password and, if Call Back Security is enabled, a specific phone number the RASFinder must call to establish the connection with the remote user.

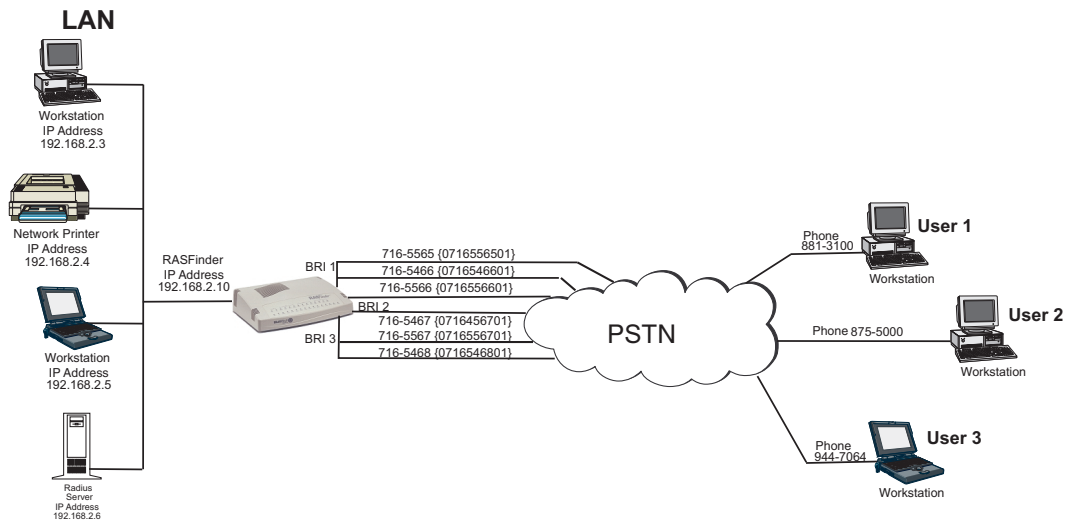


Figure 4-1. RAS Application

Before remote users can dial into the network, either the Radius security services have to be established, or each remote user must be identified in the Remote User Data Base. Radius provides a single secure server for all remote users; whereas the Remote User Data Base utility identifies each user by User Name, Password, and a specific Call Back Number if Call Back Security is enabled. Radius and the Remote User Data Base have to have communication between the remote user and the administrator either for setting up the data base or the security services to establish a user profile. Radius also requires communication between the Radius administrator and the RASFinder administrator to set up the security features and the Radius server address.

For a typical RAS application with a Radius server providing the network security, the Ethernet (10Base-T) port of the RASFinder is connected to the IP network, the Radius server is on the backbone of the network, and the WAN ports of the RASFinder are connected to individual phone lines. During initial software installation, the **Default Parameters** dialog box is displayed with both IPX and IP protocols enabled and a default Ethernet IP address and (subnet) mask displayed. For a

RAS application using Radius on an Ethernet IP network, you would disable the IPX protocol and then change the default LAN IP address and mask to the unique IP addressing scheme for your network. The address assigned to the Ethernet port of the RASFinder can be any address that is recognizable by your network's backbone.

After you enter your LAN IP address information and six sequential WAN addresses have been automatically placed in the Remote address for WAN 1 thru WAN 6 fields, ensure that the Enable IP Routing on each WAN port is checked. This activates the WAN ports to receive calls from the remote users. At this point, the software will be downloaded to the RASFinder and then you will need to go in through the main menu to set up your ISDN connection to your Public Switched Telephone Network (PSTN) and Radius security services.

**RASFinder (RF300E) - Default Parameters for RASFinder(RF300E)**

**Name**  
 Router Name:   
 The router name is used by the RASFinder to advertise its service in the IPX inter-network or as an AG Server if that service is supported.  
 You can use the default RASFinder Name or assign a new RASFinder Name (it has to be unique to the entire network) in this field. It must be a printable ASCII string of a maximum of 8 characters.

**LAN**  
 Address:   
 Mask:   
 Default Route:   
 Enter the IP Address, Subnet Mask and Default Route for the LAN port. The IP Address uniquely specifies a node on an IP inter-network. Masks are used to specify the network or subnet portion of the IP Address.

**WAN**

Enable IP Routing	Remote Address
<input checked="" type="checkbox"/> WAN 1	<input type="text" value="200.2.9.2"/>
<input checked="" type="checkbox"/> WAN 2	<input type="text" value="200.2.9.3"/>
<input checked="" type="checkbox"/> WAN 3	<input type="text" value="200.2.9.4"/>
<input checked="" type="checkbox"/> WAN 4	<input type="text" value="200.2.9.5"/>
<input checked="" type="checkbox"/> WAN 5	<input type="text" value="200.2.9.6"/>
<input checked="" type="checkbox"/> WAN 6	<input type="text" value="200.2.9.7"/>

The Remote Address is the address given by the RASFinder when someone dials in. The remote addresses should be of the same net as the LAN Address. The host portions of the remote addresses should be different.

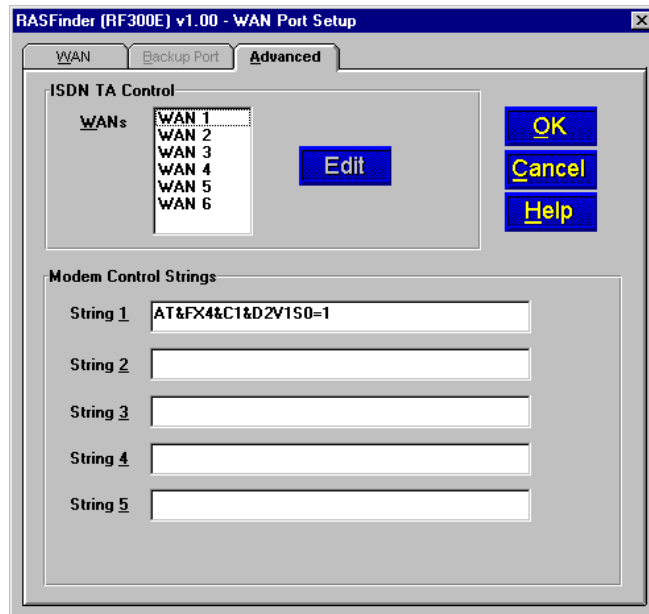
**IPX**  
 Enable IPX Routing

OK Cancel Help

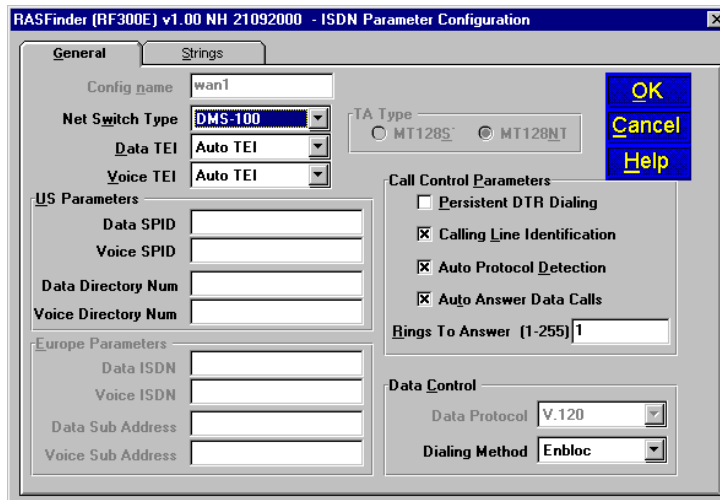
To establish your ISDN connection with your local PSTN (either the North American version or the European version), you may have to enter some ISDN parameters, e.g., switch type used by the PSTN, SPIDs and Directory Numbers for North America or ISDNs and sub addresses for European and the Rest of the World (ROW). During the provisioning of the ISDN connection with your local PSTN, the local telephone company established some ISDN parameters for your local connection. A space is provided in Before You Start Loading your Software to document these parameters. Now, in order to load this information into your RASFinder, you need to bring up the Main Menu and click on the WAN button.



From the WAN Port Setup dialog box, click on the Advanced tab to bring up the WAN Port Setup dialog box with the ISDN TA Control group highlighting wan 1. To establish your ISDN parameters, click on the Edit button and the ISDN Parameter Configuration dialog box is displayed.



In the ISDN Parameter Configuration dialog box you can define the switch type used by the local telephone company, data and voice TEI (Terminal Endpoint Identifier), your US or European Parameters, Call Control Parameters, and Data Control.



At a minimum, you will have to define the switch type and the TEIs and you may have to define the US or European Parameters if required by your local telephone company. Three switch types are defined for the US Parameters (DMS100, AT&T5ESS, and NI1), this covers the North American requirements. The European switch types are VN4 for France, NET3 for Euro, and INS64 for Japan. The data and voice TEI selections are disabled, auto TEI, or zero to 63. These parameters are determined by the local telephone company, so all you have to do is enter exactly what is provided in the your Before You Start Loading your Software listing.

In our RAS Application example in Figure 4-1, the telephone switch at the local telephone company is a DMS-100 and the local telephone company provisioned the ISDN lines with a data and voice TEI of Auto TEI. This allows the local telephone company to dynamic assigned the TEIs each time a connection is made.

Now, for the US or European Parameters which you may or may not have to enter, this depends on how the local telephone company is provisioning your ISDN connection. If the telephone company does not require this information, and the default Call Control Parameters and Data Control settings or OK, you would be done with your ISDN Configuration and ready to set up your Radius security services.



But if your local telephone company requires either SPIDs and/or Directory Numbers for the US Parameters or ISDNs and Sub Addresses for the European Parameters, you will have to enter these fields for each WAN port on the RASfinder. A word of caution at this point with respect to entering this type of information, your need to ensure that these fields are filled in exactly as they are provided from your local telephone company, because the SPID and DN or ISDN and sub address have to correspond to the BRI line coming into the RASFinder and the WAN ports assigned to that BRI line. For if the SPID or ISDN is not on the same BRI line that is provisioned by the local telephone company, the call will not be completed.

A SPID (Service Profile Identifier) is a 12-digit number that is supplied by your local telephone company which encompasses the phone number.

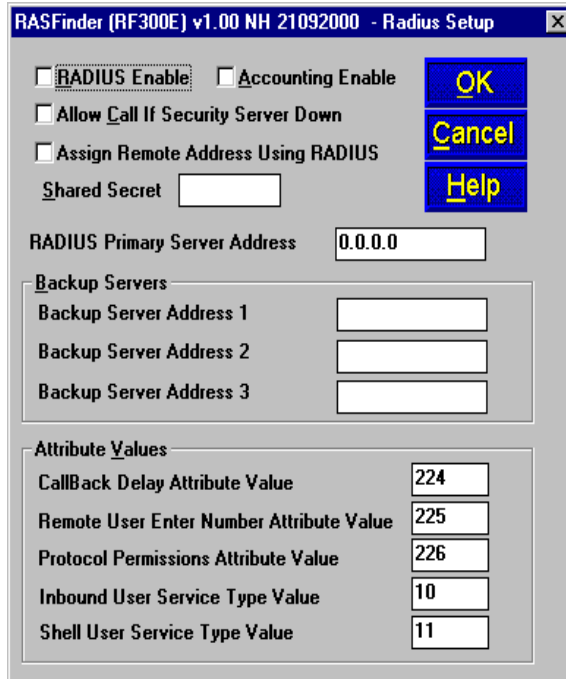
A Data or Voice Directory Number (DN) is the telephone number assigned to that B-channel for the BRI line (telephone line) supplied to you by your local telephone company. If a DN is assigned, then only the device associated with that WAN port will respond to the call.

In our RAS Application example in Figure 4-1, lets assume that telephone connection is being made for a US (North American) network. During the provisioning phase of setting up the local ISDN connection, the local telephone company assigned telephone number 716-5565 to the first B-channel for BRI 1 connection. This telephone number should correspond to Wan 1 in the ISDN Parameter

Configuration dialog box. The SPID for the first B-channel is 0716556501. The telephone company also assigned telephone number 716-5466 to the second B-channel for BRI 1 connection. The SPID for the second B-channel is 0716546601. In our example application, the ISDN Parameter Configuration dialog box for the US Parameters would contain Data SPID of 0716556501 and Voice SPID of 0716546601. If you want either of these calls to be directed to the device connected to Wan 1 or Wan 2 you would also enter the telephone number in the Data or Voice Directory Num field. So for example, if you wanted the Data SPID 0716556501 to be directed to the device on your network associated with Wan 1, you would enter telephone number 7165565 in the Data Directory Num field for Wan 1. If you wanted the calls directed to the second B-channel of BRI 1 to go to the device on your network that is associated with Wan 2, you would enter telephone number 7165466 in the Voice Directory Num field for Wan 1. When you have finished entering the parameters for Wan 1, you click the OK button and you will be returned to the dialog box with the ISDN TA Control group. You would then change to the next Wan number to be configured in the ISDN Parameter Configuration dialog box. When you have configured all three of the BRI port or the ports connected to the local telephone company, you can begin setting up your Radius security services.

To enable the Radius security services, you need to establish communications between the Radius server and the RASFinder. The Radius security service options are defined on the **Radius Setup**

dialog box. To provide vendor-specific configuration for the Radius server, you need to bring up the main menu, hit the PPP/SLIP button, and click the RADIUS button in the **PPP Port Setup** dialog box.



The **Radius Setup** dialog box enables the RADIUS option, establishes accounting, enables call if security server is down, assigns a remote address using the RADIUS, provides a window for the shared secret, and indicates the primary RADIUS server IP address. The new vendor specific attributes and services that you establish for the RASFinder can not conflict with any standard Radius attributes or any other custom attributes on the Radius Security Server. The Enable RADIUS option enables communication between the Radius server and the RASFinder. Enable Accounting option activates the accounting features which allow the Radius server to track the number of bytes sent and received, login and logout times, port number, etc. The Allow Call If Security Server Down feature can be used when the Remote User Data Base Utility is used as a backup database to the Radius security services. The Assign Remote Address Using RADIUS feature enables the Radius server to take over the addressing scheme of the WAN ports on the RASFinder.

The Shared Secret is an entry that must be obtained from the Radius network administrator and must be the same as is used on the Radius security server. The RADIUS Primary Server Address is the IP address of the Radius security server and in our typical RAS application, this address is 192.168.2.6. If one or more backup Radius servers are used in your network, then their IP addresses need to be entered in the Backup Server Address 1, 2, and/or 3 fields.

The Attribute Values Group at the bottom of the **Radius Setup** dialog box have default values for each of the three attributes and two services.

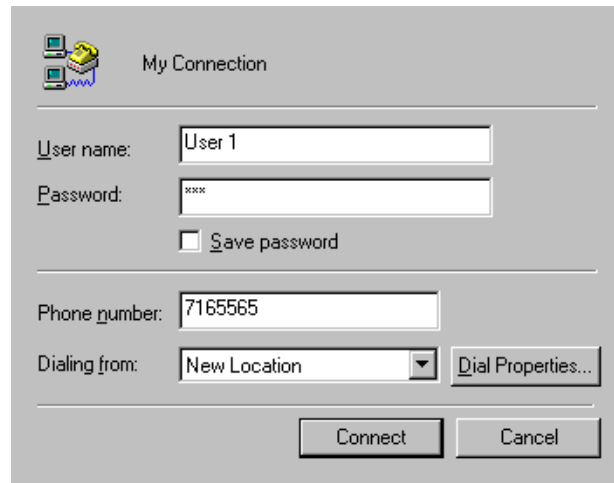
The three new attributes are vendor-specific attributes and may have to be added to the Radius server dictionary. The first attribute is Callback-Delay with a value of 224. The Radius server is set up with a delay time for calling back the remote user. The Remote User Enter Number Attribute Value has a value of 225. This attribute specifies a telephone number of where a remote user can be called back if he/she is not at their usual telephone number provided in their user profile. The remote user would have to give that new phone number to the Radius network administrator so the RASFinder will know that the remote user is at a different phone from the one in their user profile.

The Protocol Permissions Attribute has a value of 226 and the values associated with the attribute are “1” for IP, “2” for IPX, and “3” for Spanning Tree.

The Inbound User Service Type Attribute has a value of “10” and an associated value of “6”. This attribute enables the remote user to have inbound access to the network only; in other words, this attribute *adds* inbound access to the remote user’s profile.

The Shell User Service Type Attribute has a value of “11” and also an associated value of “6”.

After these new attributes are added to the Radius server and the user profile is established, a remote user (in our typical RAS application with Radius, Remote User 1, for example) could call into the RASFinder and identify themselves by their user name and password. Remote User 1, in our typical application, can initiate a dialup session by entering their User name and password in the Dial-Up Networking (My Connection) dialog box and the phone number of the WAN port on the RASFinder that User 1 is going to be connected to. In this application, remote user 1 could dial 716-5565 to connect to WAN port number one on the RASFinder.



At this point, Remote User 1 has access to the services on the LAN. For instance, if he/she wanted to print a report, it could be sent to the printer and printed out as if Remote User 1 was on the local area network.

## RAS Application using Remote User Data Base

The initial software loading process would be the same as for the RAS application using Radius, except that now instead of setting up Radius parameters, you will assemble a Remote User Data Base. A typical RAS application using the Remote User Data Base is shown in Figure 4-2.

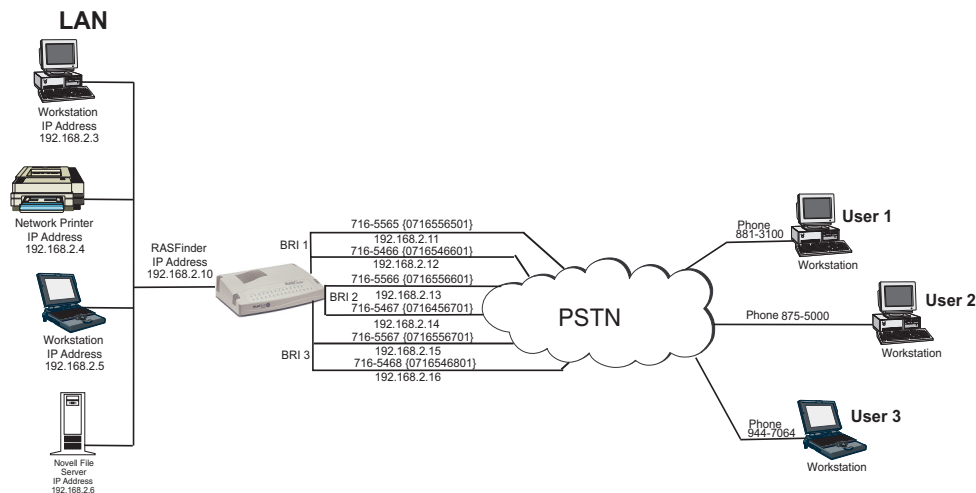
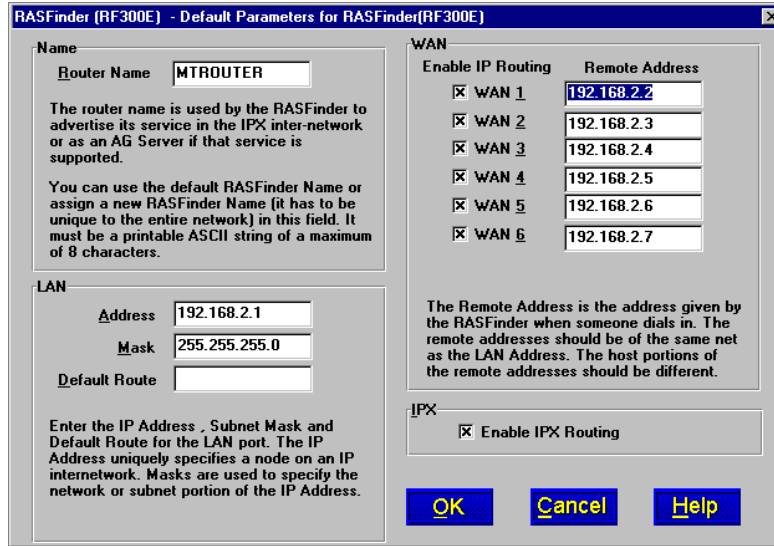


Figure 4-2. RAS Application using Remote User Data Base

During the software loading process when the **Default Parameters** dialog box is displayed, both IPX and IP protocols are enabled and a default Ethernet IP address and (subnet) mask are displayed in the IP LAN group. For this RAS application, you would disable the IPX protocol and then change the default LAN IP address and mask to the unique IP addressing scheme for your network. The address assigned to your RASFinder’s Ethernet port can be any address that is recognizable by your

network's backbone.

In this typical RAS application, the IP network address is 192.168.2.xxx. For the purpose of this discussion, we are assigning the IP address 192.168.2.10 to the Ethernet port on the RASFinder. After this address is entered into the IP Address field of the Default Parameters dialog box, the next six sequential IP addresses (192.168.2.11 thru 192.168.2.16) are assigned to the WAN ports. These six IP addresses, in the same network (with the Ethernet LAN), are associated with the respective WAN ports so that when the remote users dial into the WAN port, they *a/ways* appear (to the rest of the IP network) at these respective addresses.

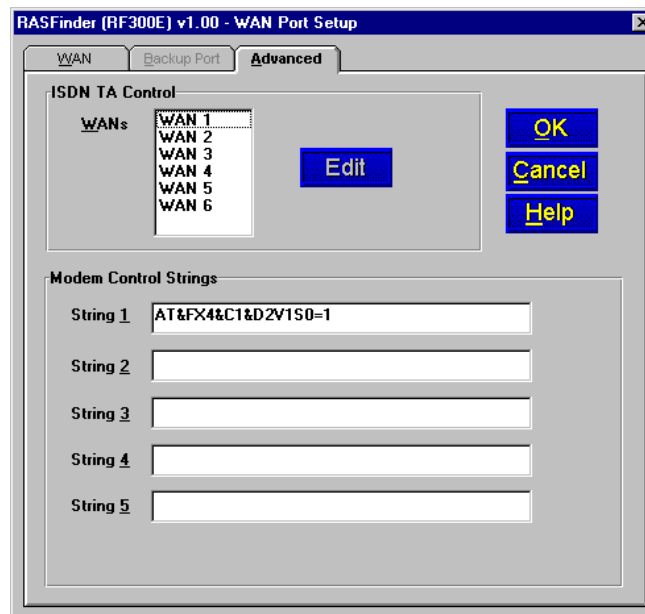


At this point, the software will be downloaded to the RASFinder and then you will need to go in through the main menu to set up your ISDN connection to your Public Switched Telephone Network (PSTN) and then establish your remote user data base.

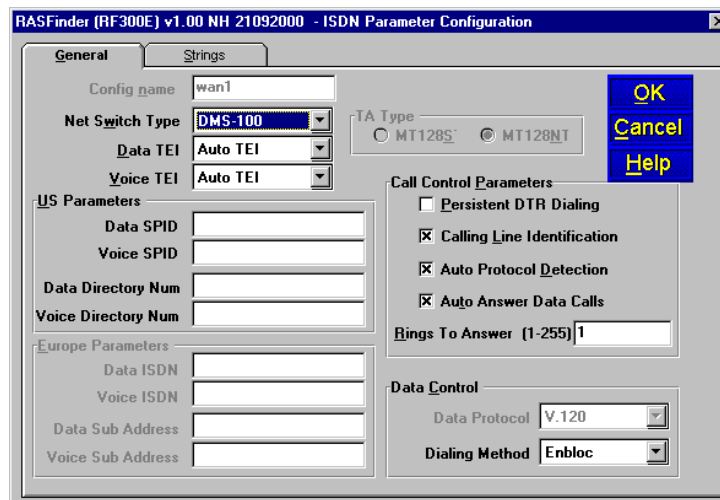
To establish your ISDN connection with your local PSTN (either the North American version or the European version), you may have to enter some ISDN parameters, e.g., switch type used by the PSTN, SPIDs and Directory Numbers for North America or ISDNs and sub addresses for European and the Rest of the World (ROW). During the provisioning of the ISDN connection with your local PSTN, the local telephone company established some ISDN parameters for your local connection. A space is provided in Before You Start Loading your Software to document these parameters. Now, in order to load this information into your RASFinder, you need to bring up the Main Menu and click on the WAN button.



From the WAN Port Setup dialog box, click on the Advanced tab to bring up the WAN Port Setup dialog box with the ISDN TA Control group highlighting wan 1. To establish your ISDN parameters, click on the Edit button and the ISDN Parameter Configuration dialog box is displayed.



In the ISDN Parameter Configuration dialog box you can define the switch type used by the local telephone company, data and voice TEI (Terminal Endpoint Identifier), your US or European Parameters, Call Control Parameters, and Data Control.



At a minimum, you will have to define the switch type and the TEIs and you may have to define the US or European Parameters if required by your local telephone company. Three switch types are defined for the US Parameters (DMS100, AT&T5ESS, and NI1), this covers the North American requirements. The European switch types are VN4 for France, NET3 for Euro, and INS64 for Japan. The data and voice TEI selections are disabled, auto TEI, or zero to 63. These parameters are determined by the local telephone company, so all you have to do is enter exactly what is provided in the your Before You Start Loading your Software listing.

In our RAS Application example in Figure 4-2, the telephone switch at the local telephone company is a DMS-100 and the local telephone company provisioned the ISDN lines with a data and voice TEI of Auto TEI. This allows the local telephone company to dynamic assigned the TEIs each time a connection is made.

Now, for the US or European Parameters which you may or may not have to enter, this depends on how the local telephone company is provisioning your ISDN connection. If the telephone company does not require this information, and the default Call Control Parameters and Data Control settings or OK, you would be done with your ISDN Configuration and ready to set up your Radius security

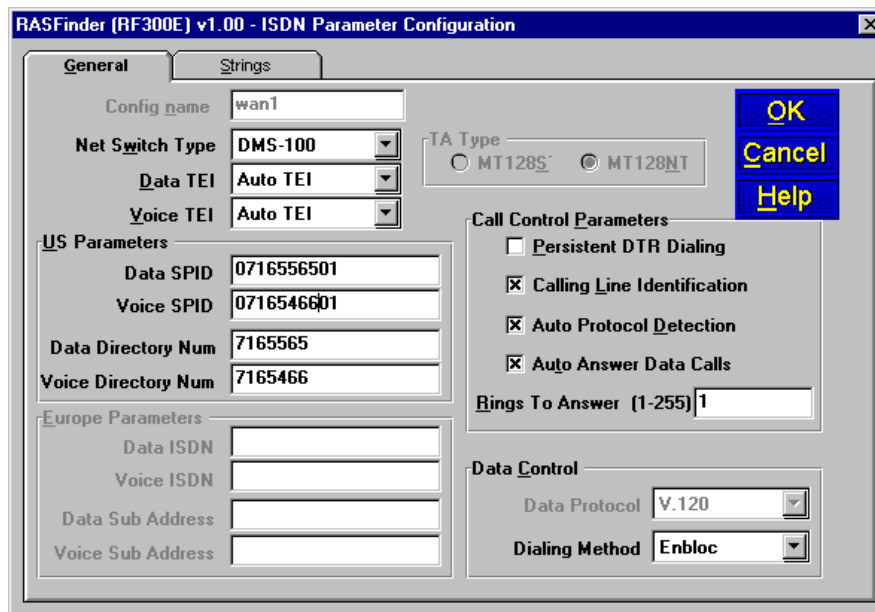
services.

But if your local telephone company requires either SPIDs and/or Directory Numbers for the US Parameters or ISDNs and Sub Addresses for the European Parameters, you will have to enter these fields for each WAN port on the RASfinder. A word of caution at this point with respect to entering this type of information, your need to ensure that these fields are filled in exactly as they are provided from your local telephone company, because the SPID and DN or ISDN and sub address have to correspond to the BRI line coming into the RASFinder and the WAN ports assigned to that BRI line. For if the SPID or ISDN is not on the same BRI line that is provisioned by the local telephone company, the call will not be completed.

A SPID (Service Profile Identifier) is a 12-digit number that is supplied by your local telephone company which encompasses the phone number.

A Data or Voice Directory Number (DN) is the telephone number assigned to that B-channel for the BRI line (telephone line) supplied to you by your local telephone company. If a DN is assigned, then only the device associated with that WAN port will respond to the call.

In our RAS Application example in Figure 4-2, lets assume that telephone connection is being made for a US (North American) network. During the provisioning phase of setting up the local ISDN connection, the local telephone company assigned telephone number 716-5565 to the first B-channel for BRI 1 connection. This telephone number should correspond to Wan 1 in the ISDN Parameter



Configuration dialog box. The SPID for the first B-channel is 0716556501. The telephone company also assigned telephone number 716-5466 to the second B-channel for BRI 1 connection. The SPID for the second B-channel is 0716546601. In our example application, the ISDN Parameter Configuration dialog box for the US Parameters would contain Data SPID of 0716556501 and Voice SPID of 0716546601. If you want either of these calls to be directed to the device connected to Wan 1 or Wan 2 you would also enter the telephone number in the Data or Voice Directory Num field. So for example, if you wanted the Data SPID 0716556501 to be directed to the device on your network associated with Wan 1, you would enter telephone number 7165565 in the Data Directory Num field for Wan 1. If you wanted the calls directed to the second B-channel of BRI 1 to go to the device on your network that is associated with Wan 2, you would enter telephone number 7165466 in the Voice Directory Num field for Wan 1. When you have finished entering the parameters for Wan 1, you click the OK button and you will be returned to the dialog box with the ISDN TA Control group. You would then change to the next Wan number to be configured in the ISDN Parameter Configuration dialog box. When you have configured all three of the BRI port or the ports connected to the local telephone company, you can begin setting up your Radius security services.

Before remote users can dial into the network, a user profile has to be set up in the proprietary remote user database using the Remote User Data base utility. This data base utility is provided with the RASFinder software. The RASFinder network administrator builds this database by adding information (for one remote user at a time) via the Add Users dialog box. The user name and password in this application must be negotiated between the RASFinder administrator and each remote user.

User names can be up to 39 characters long, with any printable characters; however, no spaces are allowed within the names. In our dialog box (above), we are using the User Name "User2." The letters will appear as all caps in the Users List; however, dial-in applications will treat the user names as case-insensitive strings, enabling the users to enter their user names as all uppercase, all lowercase, or a mixture of uppercase and lowercase.

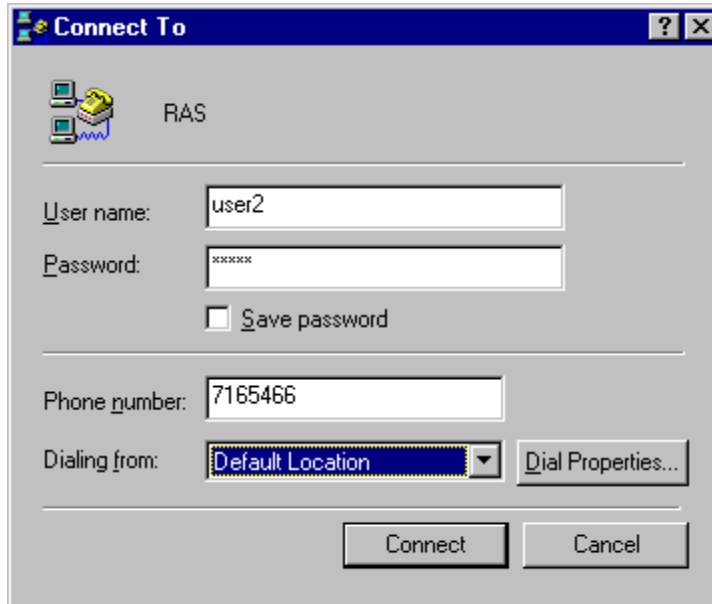
A User Password of up to 7 characters should be given each user. In the Call Back group, the Call Back option should be enabled (checked) for security purposes. If ONLY this option is checked, the remote user would be asked to supply the callback numbers when they dial into the RASFinder. If Call Back Security Enabled is also checked, the administrator controls the callback numbers through the Call Back Number field. In our typical application, User 2's phone number is 875-5000; therefore, we enter this number in the Call Back Number field. In the Dial In Ports, we have assigned User2 to WAN Port 2 with phone number 716-5466 assigned to it. This phone number will have to be entered in the Phone Number field on remote User 2's dial-up networking (My Connection) dialog box.

After the Add Users dialog box is filled in, you need to click the Rights button which brings up the User Permissions dialog box.

The User Permissions dialog box enables you to assign protocol's, user service type(s), time limits, and time of day for each user to login. The Auto Protocols allow for no auto login, login via Telnet, or

RLogin and then direct the remote user to a specific host. The User Service Types defines how the remote user is going to be allowed to use the network. For example, a remote user could be allowed Inbound Permissions using Telnet, or Inbound using RLogin. The time of day and days in which the user can access the network are the final items in the User Permissions dialog box. Once this is established for each user and the user database is loaded into the RASFinder, all the remote users can dial into the network and access the network resources according to the restrictions/permissions on this dialog box.

For example, Remote User2 (in our typical application) could initiate a dialup session by merely entering their User name and password in the Dial-Up Networking (My Connection) dialog box (see below) after having first set up a New Connection (called "My Connection") and entering the phone number of RASFinder WAN port 2 (716-5466), which is assigned to User2.



Once Remote User2 has connected and been authenticated, they have access to the services on the LAN. For instance, if he/she wanted to print a report, it could be sent to the printer and printed out just as if Remote User2 was on the local area network.



## Router Application

The second basic application for the RASFinder is LAN-to-LAN routing as shown in Figure 4-3. The RASFinder is initially configured for a RAS application. To configure the RASFinder for a router application, you have to change the WAN port addresses to be on a different network from the LAN port. The remote WAN ports have to be on the same network as the local WAN ports. You would have to change the Remote Port setup from a RAS application (Client only) to a routing application (Client or LAN). If your routing application would benefit from having the B-channels of a BRI line tied together to double your Wan speed, then you would have to enable the MultiLink Point-to-point (MLPPP) option. Finally, before you can route between LANs you would have to establish the ISDN parameters for the BRI line connecting the RASFinder to the Public Switched Telephone Network (PSTN).

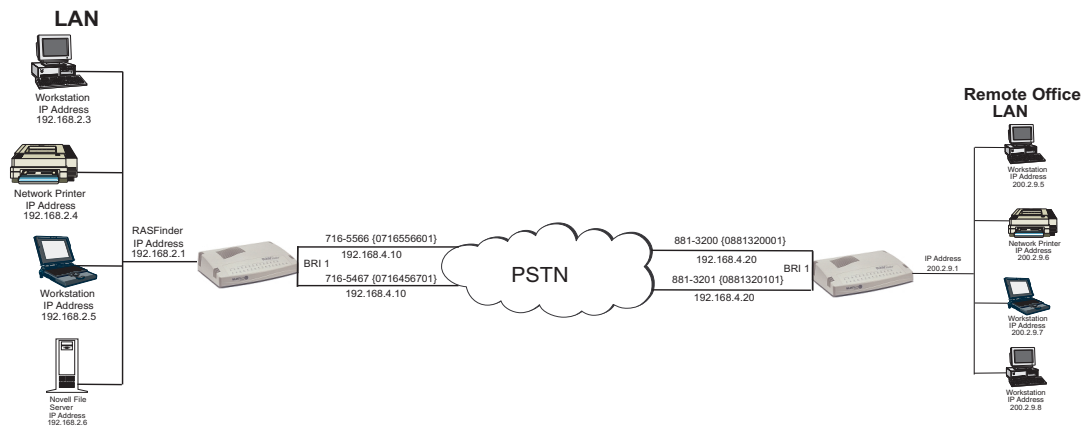


Figure 4-3. Router Application

During initial software loading, you begin to configure the RASFinder for a routing application. A typical routing application is shown in Figure 4-3 and will be used as an example in the following discussion.

**RASFinder (RF300E) - Default Parameters for RASFinder(RF300E)**

**Name**  
 Router Name:   
 The router name is used by the RASFinder to advertise its service in the IPX inter-network or as an AG Server if that service is supported.  
 You can use the default RASFinder Name or assign a new RASFinder Name (it has to be unique to the entire network) in this field. It must be a printable ASCII string of a maximum of 8 characters.

**LAN**  
 Address:   
 Mask:   
 Default Route:   
 Enter the IP Address, Subnet Mask and Default Route for the LAN port. The IP Address uniquely specifies a node on an IP inter-network. Masks are used to specify the network or subnet portion of the IP Address.

**WAN**

Enable IP Routing	Remote Address
<input checked="" type="checkbox"/> WAN 1	<input type="text" value="192.168.2.2"/>
<input checked="" type="checkbox"/> WAN 2	<input type="text" value="192.168.2.3"/>
<input checked="" type="checkbox"/> WAN 3	<input type="text" value="192.168.2.4"/>
<input checked="" type="checkbox"/> WAN 4	<input type="text" value="192.168.2.5"/>
<input checked="" type="checkbox"/> WAN 5	<input type="text" value="192.168.2.6"/>
<input checked="" type="checkbox"/> WAN 6	<input type="text" value="192.168.2.7"/>

The Remote Address is the address given by the RASFinder when someone dials in. The remote addresses should be of the same net as the LAN Address. The host portions of the remote addresses should be different.

**IPX**  
 Enable IPX Routing

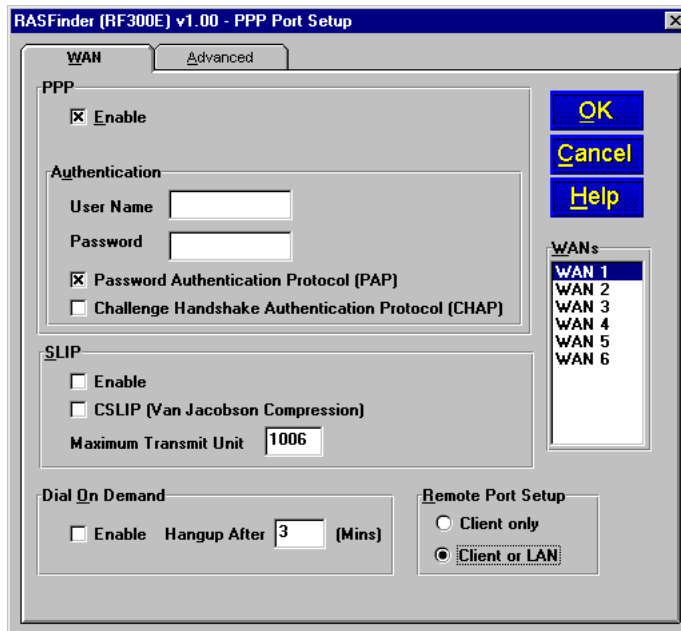
When you changed your LAN IP address in the Default Parameters dialog box to your unique LAN addressing structure, the Remote Addresses in the WAN group will change to sequential addresses of the LAN port which will not work in a routing application. The initial setup of the software defaults

to a RAS application. The Default Parameters dialog box will not allow you to change the addressing scheme of the remote WAN ports to your unique addressing structure for your routing application. Therefore, you have to leave the Default Parameters dialog box set up for a RAS application initially (during initial software installation and configuration); then later, from the main menu, you can switch your associated WAN ports from a RAS application to a routing application.

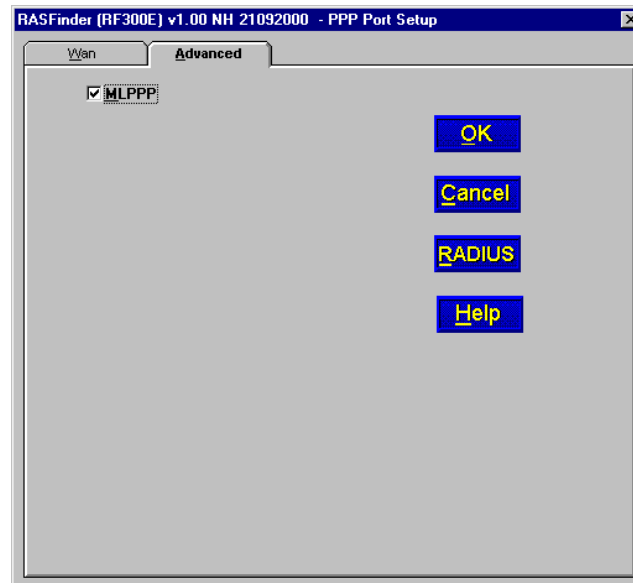
At this point, the software will be downloaded to the RASFinder and then you will need to go in through the main menu to change the Remote Port setup group from a Client Only (RAS application) to Client or LAN option for the WAN ports you need for routing, then you will be able to change those WAN ports to a different network address than your LAN port, and finally, set up your ISDN parameters for the BRI line connecting the RASFinder to the PSTN.



Before you can change your Wan ports to a different network than the LAN port, you have to click on the PPP/SLIP (Point-to-Point/Serial Line Internet Protocol) button on the Main menu and the PPP Port Setup dialog box is displayed with the WAN 1 active. In the Remote Port Setup group in the lower right of the dialog box, change from the Client only option to the Client or LAN; this disables RAS, and enables the RASFinder to communicate with *either* a remote client (PC) or a LAN for routing. The WANs group must have the Client or LAN enabled for each of the ports that are providing routing.

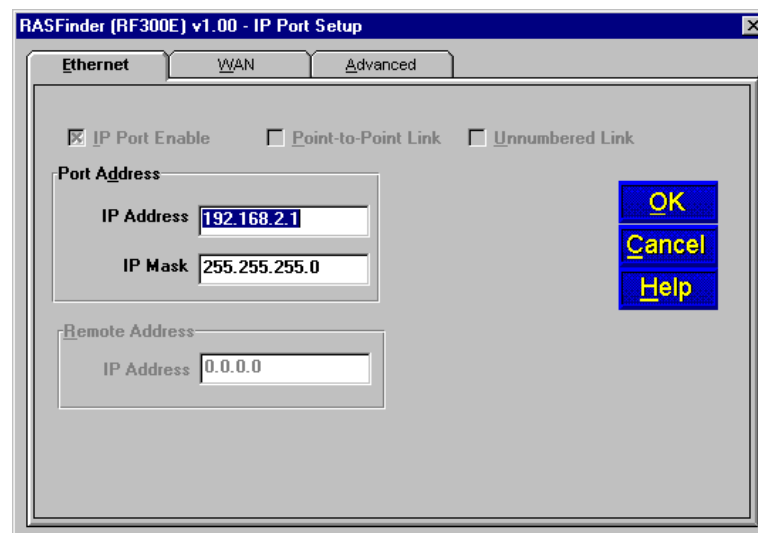


Now, you can decide if you want the B-channels of the BRI line bonded together or if you want each B-channel to act alone. To bond the two B-channels of a BRI line together, you click on the Advanced tab and ensure that MLPPP (MultiLink Point-to-Point Protocol) option is active.

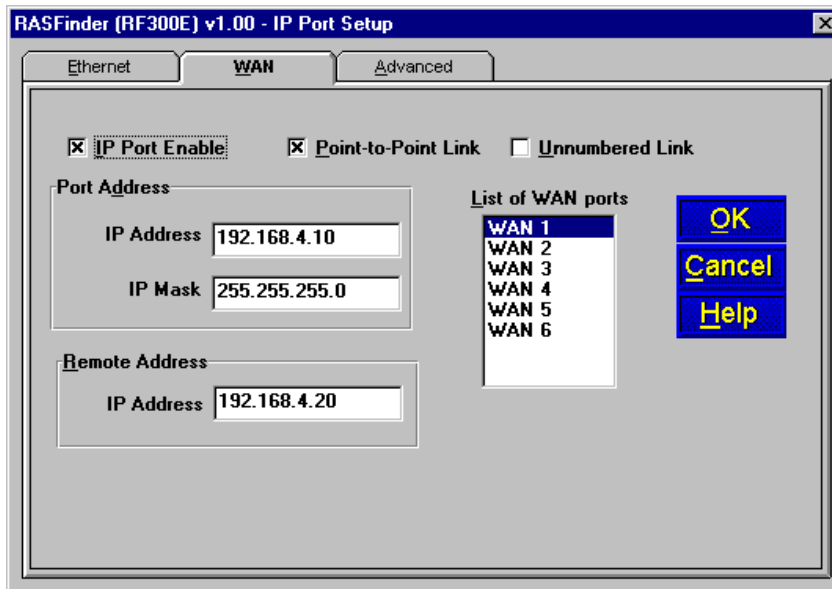


If you were to bond BRI 1 line in our Router application in Figure 4-3, you would have to change the IP addresses (WAN 1 from 192.168.2.2 and WAN 2 from 192.168.2.3 on the Corporate LAN to the same IP address, for example, you could use 192.168.4.10 for both B-channels. At the remote office LAN you would then have to change BRI 1 line to say 192.168.4.20.

Now, to configure the RASFinder for the routing application as shown in Figure 4-3 and bonding the B-channels together, you need to click on the IP button on the Main Menu. The IP Port Setup dialog box is displayed with the Ethernet tab active showing your LAN IP address.



Next, you need to click on the WAN tab to display the Port Address and Remote Address groups for WAN 1. Wan 1 is highlighted in the List of WAN ports on the right side of the dialog box. The default WAN IP addresses will be displayed in the dialog box that were set up during the software loading and initial configuration of the RASFinder. But, now you can change these addresses to fit your routing application. Above I stated that we could bond the B-channels together, so here is where we enter that information. For the Corporate LAN with the B-channels of BRI 1 bonded together and an IP address of 192.168.4.10, you would enter this in the IP Address field for the Port Address group. Set up your IP Mask accordingly, and then enter your IP Address for the Remote Office in the IP Address field of the Remote Address group (192.168.4.20).



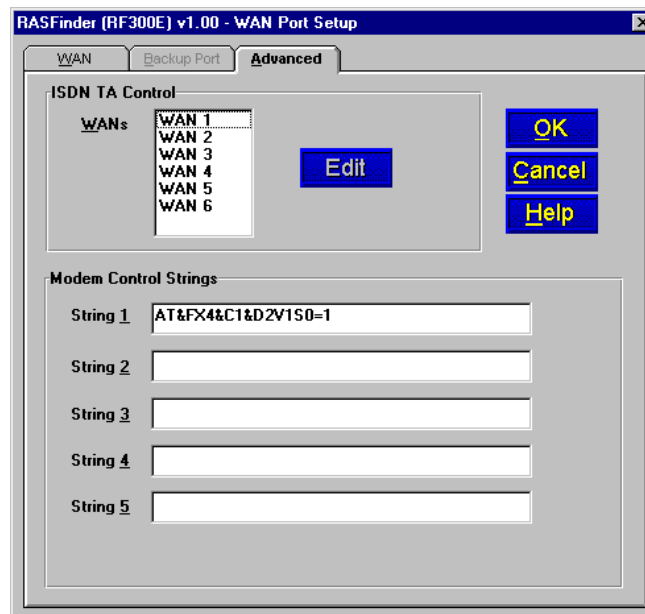
Now, you can click on WAN 2 and enter the same information for the Port and Remote Address groups. This will bond the two B-channels of BRI 1 together.

To set up the remote office LAN, go through the same process except point the WAN ports toward the Corporate LAN. The remote WAN ports could be set up with an IP address of 192.168.4.20.

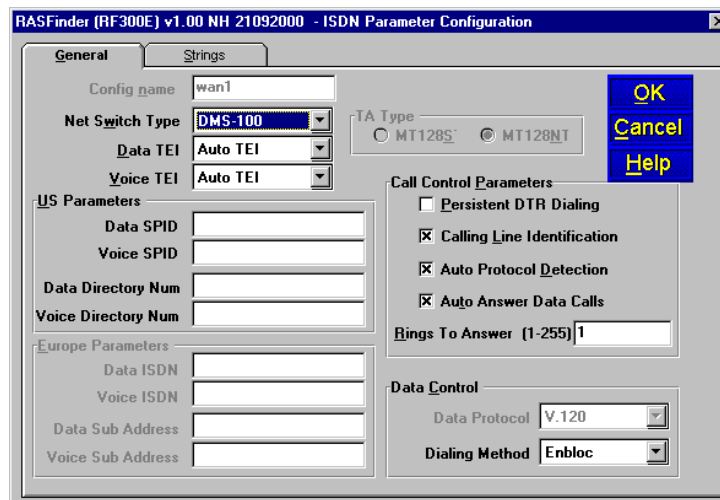
Now to establish your ISDN connection with your local PSTN (either the North American version or the European version), you may have to enter some ISDN parameters, e.g., switch type used by the PSTN, SPIDs and Directory Numbers for North America or ISDNs and sub addresses for European and the Rest of the World (ROW). During the provisioning of the ISDN connection with your local PSTN, the local telephone company established some ISDN parameters for your local connection. A space is provided in Before You Start Loading your Software to document these parameters. Now, in order to load this information into your RASFinder, you need to bring up the Main Menu and click on the WAN button.



From the WAN Port Setup dialog box, click on the Advanced tab to bring up the WAN Port Setup dialog box with the ISDN TA Control group highlighting WAN 1. To establish your ISDN parameters, click on the Edit button and the ISDN Parameter Configuration dialog box is displayed.



In the ISDN Parameter Configuration dialog box you can define the switch type used by the local telephone company, data and voice TEI (Terminal Endpoint Identifier), your US or European Parameters, Call Control Parameters, and Data Control.



At a minimum, you will have to define the switch type and the TEIs and you may have to define the US or European Parameters if required by your local telephone company. Three switch types are defined for the US Parameters (DMS100, AT&T5ESS, and NI1), this covers the North American requirements. The European switch types are VN4 for France, NET3 for Euro, and INS64 for Japan. The data and voice TEI selections are disabled, auto TEI, or zero to 63. These parameters are determined by the local telephone company, so all you have to do is enter exactly what is provided in your Before You Start Loading your Software listing.

In our Router Application example in Figure 4-3, the telephone switch at the local telephone company is a DMS-100 and the local telephone company provisioned the ISDN lines with a data and voice TEI of Auto TEI. This allows the local telephone company to dynamic assigned the TEIs each time a connection is made.

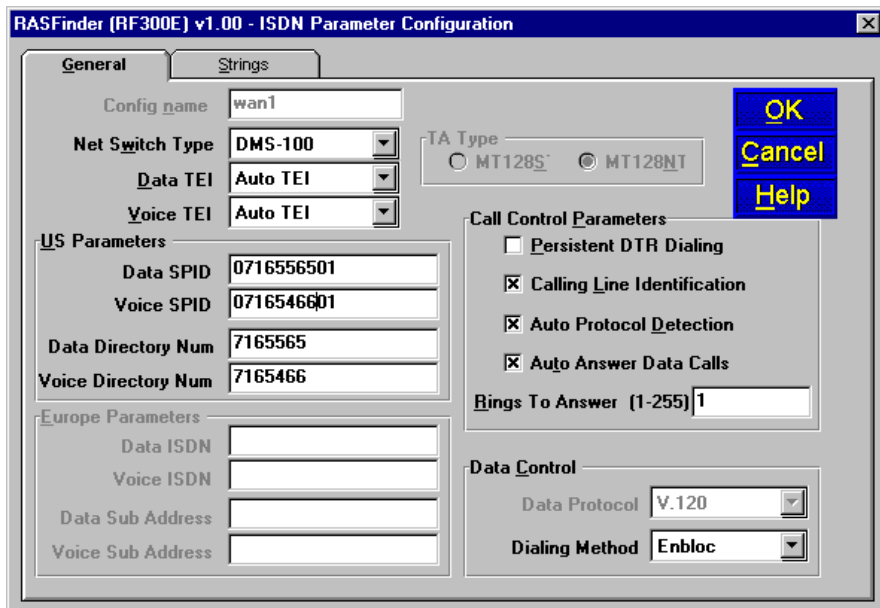
Now, for the US or European Parameters which you may or may not have to enter, this depends on how the local telephone company is provisioning your ISDN connection. If the telephone company does not require this information, and the default Call Control Parameters and Data Control settings are OK, you would be done with your ISDN Configuration and ready to start your routing.

But, if your local telephone company requires either SPIDs and/or Directory Numbers for the US Parameters or ISDNs and Sub Addresses for the European Parameters, you will have to enter these fields for each WAN port on the RASfinder. A word of caution at this point with respect to entering this type of information, your need to ensure that these fields are filled in exactly as they are provided from your local telephone company, because the SPID and DN or ISDN and sub address have to correspond to the BRI line coming into the RASFinder and the WAN ports assigned to that BRI line. For if the SPID or ISDN is not on the same BRI line that is provisioned by the local telephone company, the call will not be completed.

A SPID (Service Profile Identifier) is a number supplied by your local telephone company which encompasses the phone number.

A Data or Voice Directory Number (DN) is the telephone number assigned to that B-channel for the BRI line (telephone line) supplied by your local telephone company. If a DN is assigned, then only the device associated with that WAN port will respond to the call.

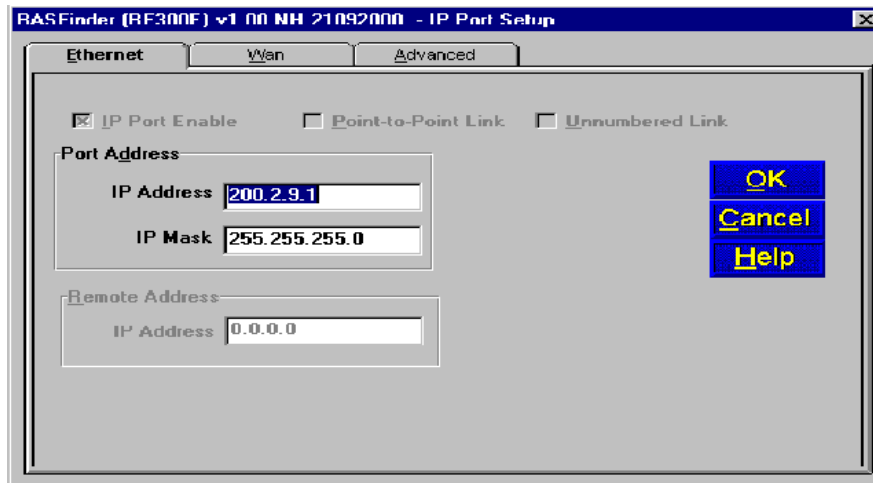
In our Router Application example in Figure 4-3, lets assume that telephone connection is being made for a US (North American) network. During the provisioning phase of setting up the local ISDN connection, the local telephone company used telephone number 716-5565 for WAN 1 of BRI 1. This telephone number should correspond to Wan 1 in the ISDN Parameter Configuration dialog box.



The SPID for the first B-channel (WAN 1) could be 0716556501. The telephone company also used telephone number 716-5466 for the second B-channel (WAN 2) of BRI 1. The SPID for the second B-channel could be 0716546601. In our example application, the ISDN Parameter Configuration dialog box for the US Parameters would contain Data SPID of 0716556501 and Voice SPID of 0716546601. If you want either of these calls to be connected to Wan 1 or Wan 2 you would also enter the telephone number in the Data or Voice Directory Num field. So for example, if you wanted the Data SPID 0716556501 to be directed to Wan 1, you would enter telephone number 7165565 in the Data Directory Num field for Wan 1. If you wanted the calls directed to the second B-channel of BRI 1 to go to Wan 2, you would enter telephone number 7165466 in the Voice Directory Num field for Wan 2. When you have finished entering the parameters for Wan 1, you click the OK button and you will be returned to the dialog box with the ISDN TA Control group. You would then change to WAN 2 and configure the ISDN Parameter Configuration dialog box. When you have configured both BRI ports connected to the local telephone company, you are now ready to start routing between LANs.

## IP Setup

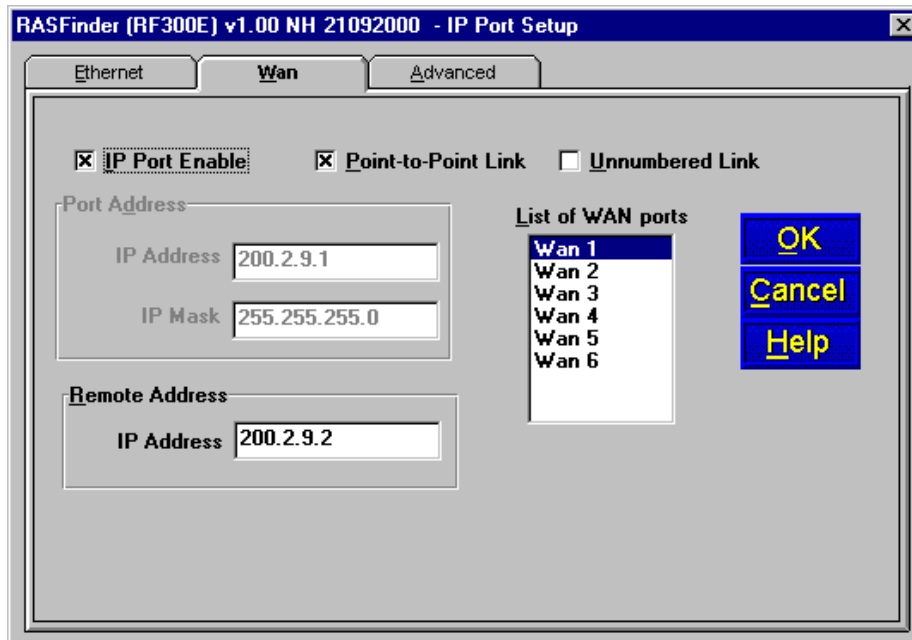
The **IP Port Setup** dialog box enables you to change the IP routing capabilities that were set up during software installation. This dialog box has three tabs: Ethernet, WAN, and Advanced.



The **Ethernet** tab enables you to configure two parameters relating to the Ethernet port. For example, you can change the Ethernet port IP Address and IP mask.

### WAN Tab

If you enable the IP routing master control on the Advanced tab but disable the control on this tab, all IP packets received or to be transmitted on this WAN port will be discarded. Even if bridging is enabled, the packets will not get across the link.

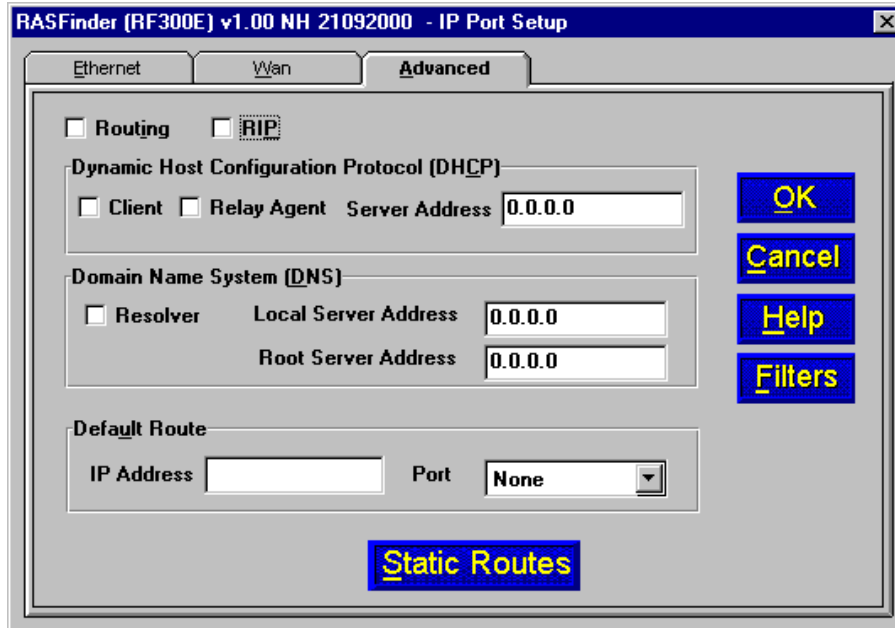


The Unnumbered Link option can be selected (checked) for the WAN ports for point-to-point links. When selected, it disables the Port Address and Remote Address groups. Unnumbered links are useful only between two routers; in this case, local and remote. When running RIP over a PPP link, both ends of the link must be either unnumbered or numbered with the same IP subnet. An advantage of not assigning an IP address to each WAN port is that you conserve valuable network and subnet numbers.

Remote **IP Address** defines the IP address for the destination end of a point-to-point link and is necessary only if the selected WAN port has been enabled for point-to-point operation.

Note: the remote IP address must fall within the same IP network as the local WAN IP address.

The **Advanced** tab is used to enable IP routing and RIP authentication and defines how the Dynamic Host Configuration Protocol (DHCP) and Domain Name System (DNS) servers are to be used. This tab is also used to set up the default route, any filters, and Static Routes.



The **Routing** option is normally checked; however, if you do not wish to have IP packets routed, then uncheck this item. If IP routing is disabled and bridging is enabled, IP packets are bridged; i.e., IP packets are transferred.

The **RIP** option enables RIP based routing. RIP (Routing Information Protocol) is a protocol used among routers to exchange routing table information. RIP is the most common protocol used in both IP and IPX networks. It is also used internally by client workstations in IPX networks to obtain routes (shortest, or otherwise) to any distant network. RIP based routing should normally be enabled. It can be disabled, however, if you are using WAN links in Dial on Demand mode. For DOD links, disabling RIP will reduce traffic on the link as it will also disable periodic RIP broadcasts. RIP routing on a given port will be automatically turned off when Dial on Demand is enabled on the PPP Port Setup tab for the WAN port.

The **DHCP (Dynamic Host Configuration Protocol)** group enables you to set up the WAN ports as client-only. Then, a PPP client connected to the WAN port will be on the same IP network as the LAN port of the RASFinder. This feature can save some extra IP addresses that otherwise would have been taken up by the WAN port. Enabling the Client option allows the RASFinder to dynamically get an IP address for a PPP client coming up on one of its "Client-only" WAN ports. When this option is enabled, there must be a DHCP server or a DHCP relay agent on the connected LAN in order for the RASFinder to acquire an appropriate IP address.

When the router is configured for remote access, the DNS Resolver needs to be enabled so that applications such as the terminal server will support Domain Names. The dotted decimal IP address of the Local DNS server should be entered in the field provided.

The **Static Routes** feature allows a router to direct packets from the local network down a predefined path (static route) to a remote network. Static routing is normally used when a part of an internetwork can be reached by only one particular path. Static routes are manually configured routes that specify the transmission path a data packet must follow based on the data packet's destination address. A static route can be setup on the corporate network so that a client pc on the manufacturing network



could send a document to the corporate printer.

This static route is shown in the top network in Figure 4-4. A static route can also use an unnumbered link to provide a particular route for a remote server to appear as a server on the corporate network. The unnumbered link is shown in the middle network in Figure 4-4.

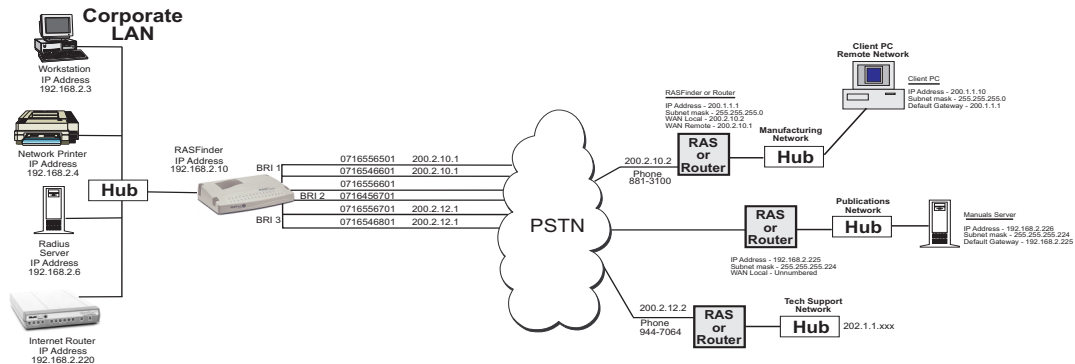
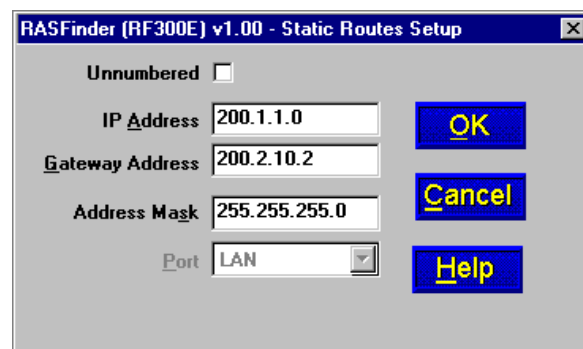


Figure 4-4. Static Routes

In our first example above, where a data packet from the remote client PC on the manufacturing network is being sent to the corporate printer, a static route would be established on the corporate RASFinder to have WAN 1 and WAN 2 with network address of 200.2.10.1 and a gateway address of 200.2.10.2, the remote network. The Static Routes Setup dialog box would contain the address of 200.1.1.0 in the **IP Address** field and a **gateway address** of 200.2.10.2. The **Unnumbered** option would be left unchecked in this example. The IP Address field contains the address of the target host or network, a PC on the manufacturing network. The **Gateway Address** is the address of the local router on the manufacturing network (200.2.10.2) on the next hop toward the target host. The **Address Mask** is the IP subnetwork mask (255.255.255.0) of the target host. The **Port** field is inactive, greyed out in this example.

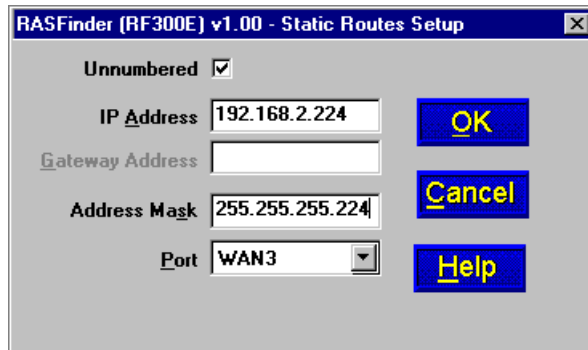


This example establishes a static (direct) path for the user on the client pc on the manufacturing network to send a letter to the corporate LAN and have it printed on the corporate network printer. The control for this static path is the RASFinder on the corporate LAN.

Now, for our second example of an unnumbered link where we want a server on a remote network to appear as a device on the corporate LAN. Lets use the example of the Internet router on the corporate network wanting to provide manuals from the Publications network to Internet users. Lets say that the Manuals Server on the Publications Network contains released manuals that a customer can download from the corporate network. So in order to have the Manuals Server appear on the Internet router, we need to set up the corporate RASFinder with an unnumbered link and for the purposes of our example, lets use the middle two WAN ports (WAN 3 and WAN 4). Also, the Internet router will have a default route of 192.168.2.224 with a subnet Address Mask of 255.255.255.224, and a Gateway Address of 192.168.2.10. The Manuals server would need a gateway pointing to the corporate RASFinder. The gateway address on the Manuals server could be 192.168.2.225.

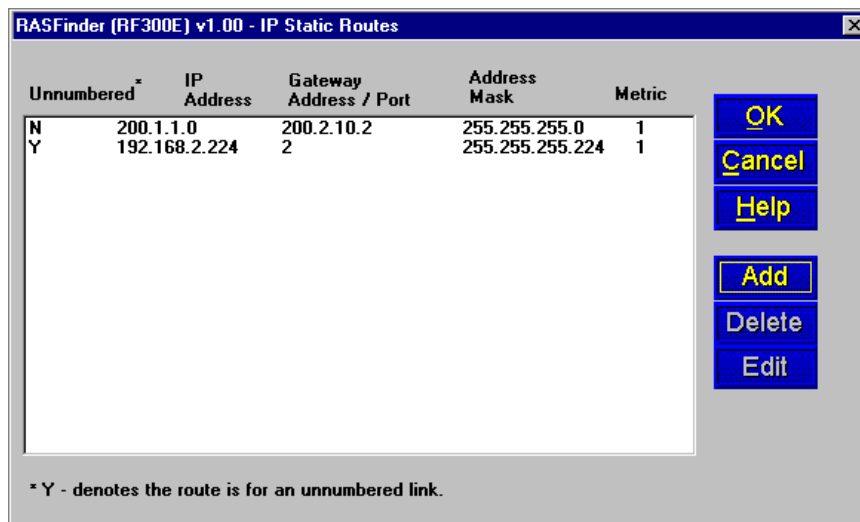
So, for this application to work, you need to set up a static route on the Corporate RASFinder of 192.168.2.220 which is pointing at the Internet router. You then need to go into the IP Port Setup dialog box, select WAN tab, highlight WAN 3, and activate the Unnumbered Link option. Then do the same thing for WAN 4. When you do this, the Port Address and the Remote Address groups become inactive. Now, you need to check the PPP/SLIP button on the Main menu and ensure that the Remote Port Setup group for WAN 3 and WAN 4 are set to Client or LAN.

Now go back to the IP Port Setup dialog box and hit on the Advance tab, then click on the Static Routes button. This brings up a blank IP Static Routes dialog box, hit the Add button to bring up the Static Routes Setup dialog box and when you enable the Unnumbered option, the Gateway Address option becomes inactive.



Now, for the IP Address field we want the address of the Internet router on the Corporate LAN which in our unnumbered example is 192.168.2.224. In order for the Manuals server on the Publications network to appear on the Corporate LAN, we need to subnet the Manuals server with an Address Mask of 255.255.255.224. The Port option identifies the WAN ports on the Corporate RASFinder that are unnumbered. In our example, WAN 3 and WAN 4 are the unnumbered ports. So you would develop the Static Routes Setup dialog with WAN 3 as the WAN port and establish a second Static Routes Setup dialog with the only change from the above dialog box is that WAN 4 is the port number.

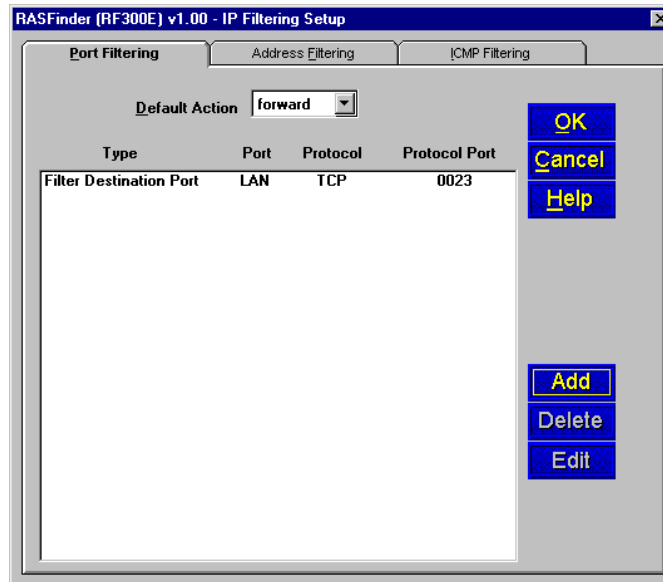
When we click on the OK button for the second Static Routes Setup dialog box, the IP Static Routes dialog box now displays two examples of static routes.



To complete the Static Route application, the Publications network RASFinder or router, depending on the type of device used on the network would need a default route of 192.168.2.226 that is looking at the Manuals Server. The Ethernet port IP address could be 192.168.2.225 with a net mask of 255.255.255.224.

## Filters

The network administrator can set up filters on the RASFinder for better control. Filtering can be used when you want to block all packets originating from a specific destination (called source address filtering) or all packets heading for a particular destination (called destination address filtering). Filters can be set up to exclude packets of a particular protocol (TCP or UDP) or any particular field in a LAN packet. The **IP Filtering Setup** dialog box lists the port, address, or Internet Control Message Protocol (ICMP) filtering for the IP protocol.



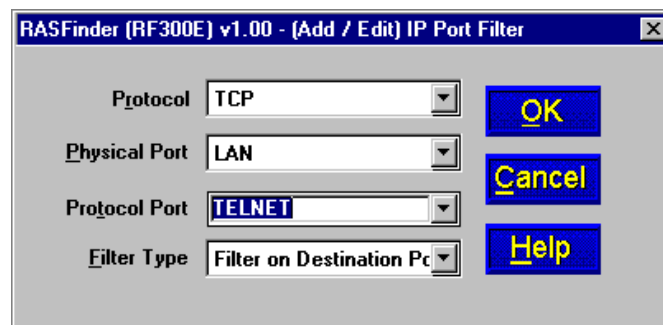
Initially, the filtering list window, i.e., the window area that displays the Type, Port, Protocol, and Protocol Port information is blank. This information is displayed in the window when the Add/Edit Port or Address Filter dialog box is filled out.

**Note:** When filters are installed, the RASFinder needs to do extra processing (i.e., it needs to look into each packet that has to be routed or bridged). Thus, installing too many filters may lead to performance degradation.

Port filtering filters or forwards IP packets based on their specific purpose; i.e., whether they are Telnet (TCP based) or TFTP (UDP based) packets. Address filtering filters or forwards packets based on their source or destination IP address. Separate filtering support is provided for specific kinds of received ICMP packets.

The filtering list window on the Port Filtering tab (above) displays the filter Type, the physical Port (LAN, or one of the WAN ports), the Protocol (TCP or UDP), and the Protocol Port. On the Address Filtering tab (not shown), the Protocol and Protocol Port columns are replaced by IP Address.

To add or edit a filter listing, the **Add/Edit IP Port (Address) Filter** dialog box is used. This dialog box enables you to create an entry which is then displayed in the filtering list window. In the example

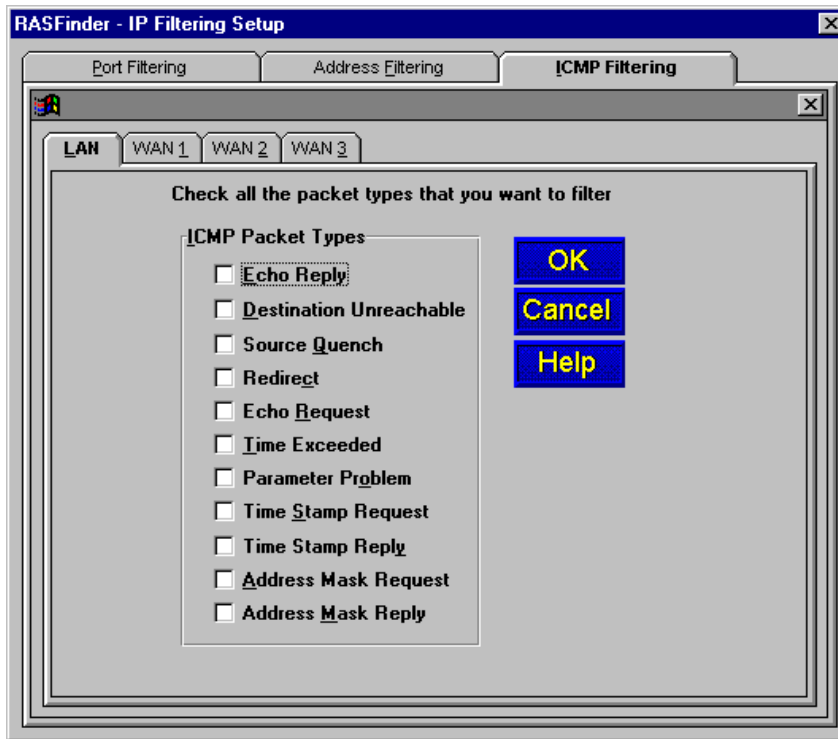


Add/Edit IP Port Filter dialog box, the protocol that is going to be filtered is TCP, the physical port on

which the filtering is going to take place is the LAN port, the protocol port is telnet which translates into protocol port number 0023 in the filtering list window, and the filter type is Filter on Destination Port which means to drop all IP packets whose destination protocol port is telnet.

Address filtering uses the IP address in the IP Address field (example, packets with address 192.168.2.40), applies filtering to the physical port listed in the Physical Port field (LAN), and if the Filter Type is Filter on Destination Address that means that all packets with an IP address of 192.168.2.40 that are destined for the LAN port are blocked.

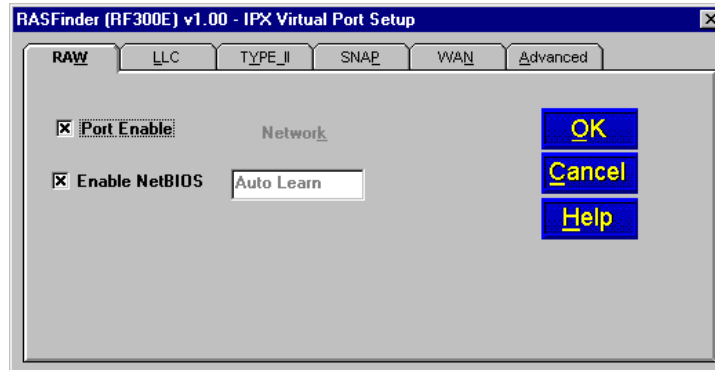
ICMP filtering provides separate filtering support for specific kinds of received ICMP packets. ICMP filtering is used in IP networks as an internal protocol for nodes to exchange control and diagnostic information. Applications normally do not use ICMP filtering for any purpose.



You can select ICMP filtering on your LAN or WAN ports and the type of filtering on each port by choosing the filtering type from the ICMP Packet Types list.

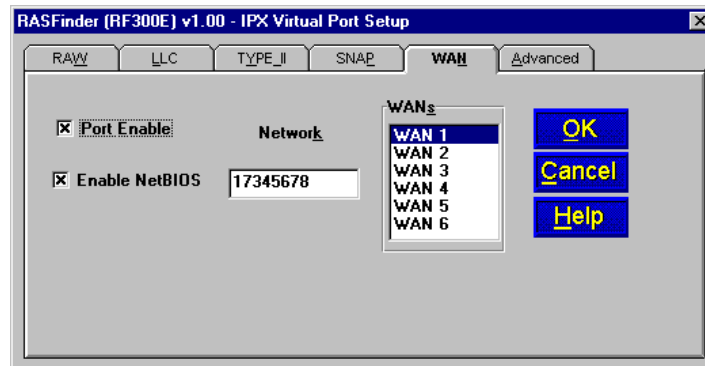
## IPX Setup

The **IPX Virtual Port Setup** dialog box is used to control the four frame types and set up the WAN ports of the RASFinder. The Advanced tab opens an IPX general setup window used to enable or disable IPX routing and autolearn of Ethernet network numbers.



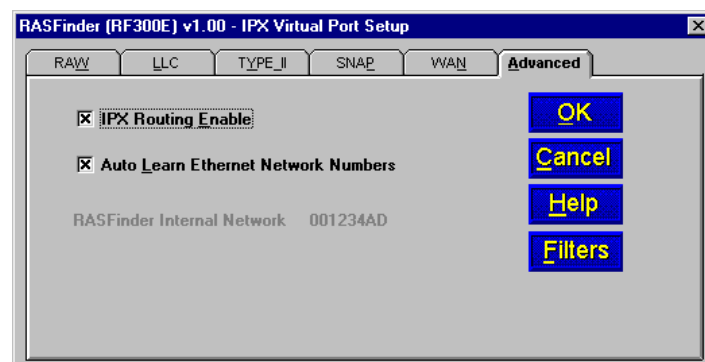
In IPX based networks using Ethernet, LAN segments can support the use of four different Ethernet frame formats over the same physical link (provided each frame type has a unique network address as a virtual port).

The Wan tab allows you to enable or disable IPX routing on the WAN ports and change the network number for the WAN ports. The IPX WAN network number has to be the same on both ends of the link and must be unique throughout the internetwork. If a WAN port is configured in a point-to-point operation, both WAN network numbers have to be the same and unique.



**NetBIOS**, when enabled, enables the transport of Novell encapsulated NetBIOS packets on the specified virtual IPX port. Refer to Novell documentation regarding NetBIOS operation over NetWare based LANs.

The Advanced tab controls the master routing of the protocol and auto learn of Ethernet network numbers, defines the broadcast name of the RASFinder, and enables IPX filtering.



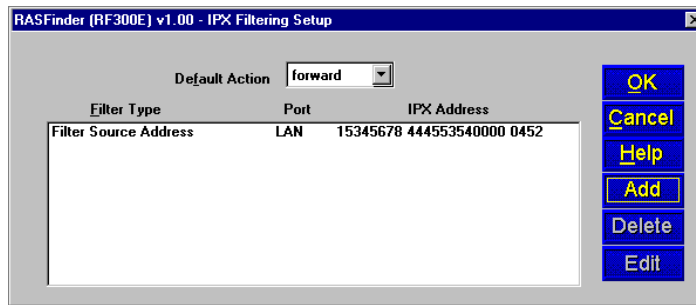
If bridging of IPX packets is desired, IPX routing must be disabled and frame type support for the frame type must be enabled.

If there is a server on the local segment, then IPX network number auto learn should be enabled. If there is no server, or if for some reason the RASFinder comes up before the server does, the RASFinder will default to some random network numbers after a short period of time.

## IPX Filters

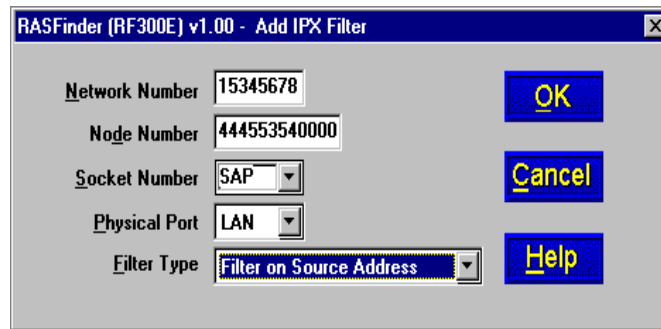
The network administrator can set up filters on the RASFinder for better control. IPX packet filtering can be set up to selectively filter or forward packets based on the IPX address.

Filtering can be used when you want to block all packets originating from a specific destination (called source address filtering) or all packets heading for a particular destination (called destination address filtering). Filters can be set up to exclude packets of a specific port. The **IPX Filtering Setup** dialog box lists the filter type, port, and IPX address. Initially, the filtering list window, i.e., the window area that displays the Filter Type, Port, and IPX Address information is blank. This information is displayed in the window when the Add/Edit IPX filter dialog box is filled out.



**Note:** When filters are installed, the RASFinder needs to do extra processing (i.e., it needs to look into each packet that has to be routed or bridged). Thus, installing too many filters may lead to performance degradation.

The Add or Edit IPX Filter dialog box allows you to enter a network number and node number, and define a socket number, physical port, and filter type. The Network Number defines the physical port which is defined by turning off AutoLearn Ethernet Network Numbers option in the IPX Virtual Port Setup dialog box under the Advanced tab. The Node Number is a 12-digit alphanumeric MAC



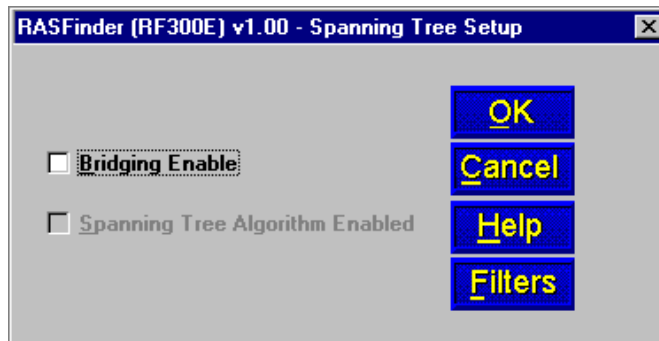
Address of the Ethernet NIC that is providing your Ethernet interface. The Node Number is defined in the IP Configuration dialog box under the Adapter Address in the Ethernet Adapter Information group. The Adapter Address is presented with dashes between each set of two alphanumeric digits. These dashes can not be used in the Node Number. The IP Configuration dialog box is accessed from a DOS prompt by entering winipcfg.

The socket number, physical port, and filter type are provided in drop down lists. Three socket number selection are provided; NCP, RIP, and SAP. The physical port lists the available port for which filtering can be accomplished; LAN and the WAN ports. The filter type defines whether you are going to forward or filter depending on the source or destination address.

## Spanning Tree Setup

This dialog box lets you configure the parameters for transparent bridging or bridging using Spanning Tree Algorithm as specified in IEEE 802.1d standard. Transparent bridging occurs between two remote Ethernet LANs.

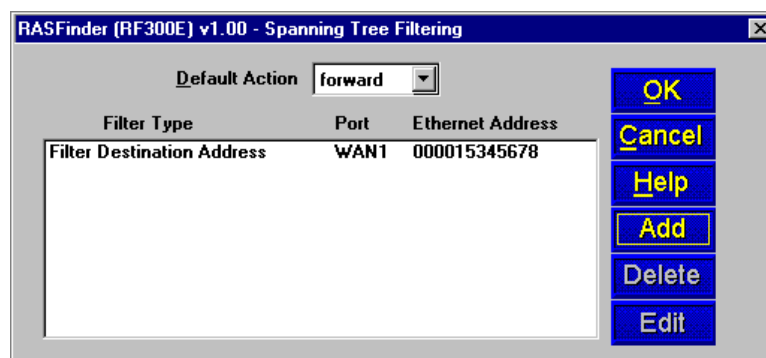
Spanning Tree Algorithm is a protocol specified by the IEEE 802.1d standard for use by bridges to perform bridging. Bridges implementing this protocol interact with each other so as to prevent bridging-loops in an internetwork with redundant links to the same networks. This algorithm also allows for automatic use of alternative routes (provided there are redundant paths to the destination) in case the original route is unavailable for some reason.



Bridging needs to be enabled to support networking protocols such as NetBIOS. However, if you are using only IP and IPX, the RASFinder will operate more efficiently if you leave bridging disabled.

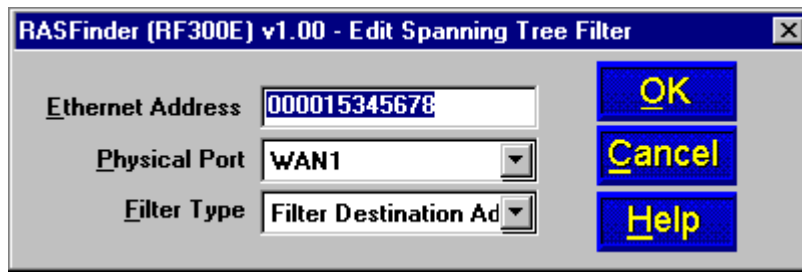
The **Filters** button enables the construction of a filtering database. Packets whose Ethernet source address or destination address is not found in the filtering database will either be filtered or forwarded, depending on the setting of the **Default Action** field, with a default setting of “forward.”

Filtering can be used when you want to block all packets originating from a specific destination (called source address filtering) or all packets heading for a particular destination (called destination address filtering). Filters can be set up to exclude packets of a specific port. The **Spanning Tree Filtering Setup** dialog box lists the filters by filter type, port, and Ethernet address. Initially, the filtering list window, i.e., the window area that displays the Filter Type, Port, and Ethernet Address information is blank. This information is displayed in the window when the Add/Edit Spanning Tree Filter dialog box is filled out.



**Note:** When filters are installed, the RASFinder needs to do extra processing (i.e., it needs to look into each packet that has to be routed or bridged). Thus, installing too many filters may lead to performance degradation.

The add or edit **Spanning Tree Filter** dialog box allows you to enter the Ethernet address (for example 00015345678) to which you want to apply filtering, the physical port (WAN 1) on which the filtering is going to be applied, and the filter type in our example of Filter Destination Address.

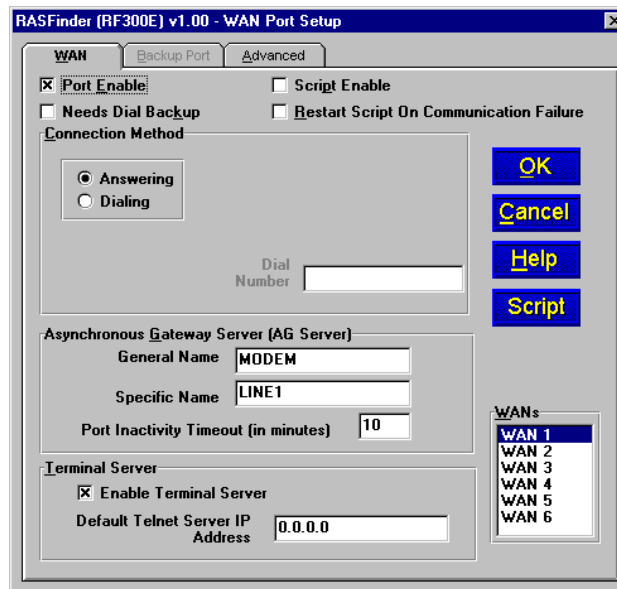


This means that all packets with a destination address of 00015345678 going to WAN 1 are dropped.

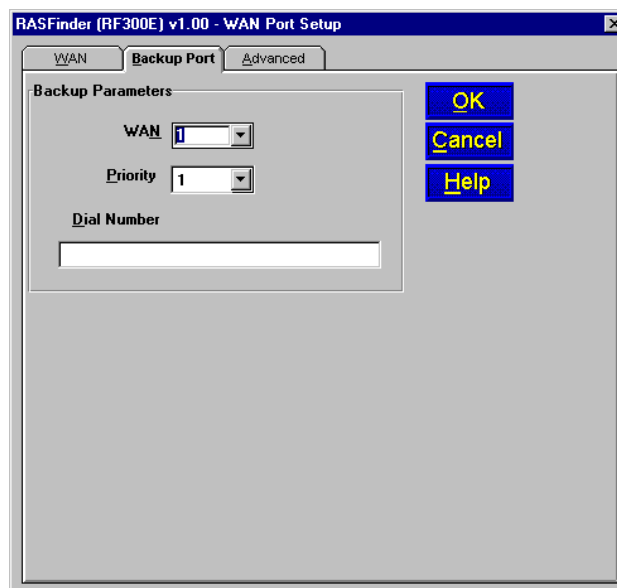


## WAN Port Setup

The **WAN Port Setup** dialog box controls how each WAN port is configured. The options at the top of the dialog box (i.e., Port Enable, Needs Dial Backup, and the Scripting options) can be assigned to each port listed in the Wans group in the lower right part of the dialog box. The Connection Method can be set for either Answering or Dialing for each port listed in the Wans group. When the dialing option is selected, the Asynchronous Gateway Server [AG Server] and Terminal Server groups become inactive. To configure a WAN port for dial backup, you need to click on the Needs Dial Backup option and then click on the Backup Port tab and enter the call back phone number, WAN port, and priority of the call.



If a WAN port **Needs Dial Backup** in case it loses carrier (i.e., the Carrier signal, DCD, goes down), then Wan 6 is dedicated for this purpose. Therefore, five of the six WAN port can be used for dial backup. When the Needs Dial Backup option is selected, the call back number needs to be entered in the Dial Number field of the Backup Parameters. The WAN port number has to be specified and the priority of the call back has to be specified. The call back priority ranges from No Priority to four.



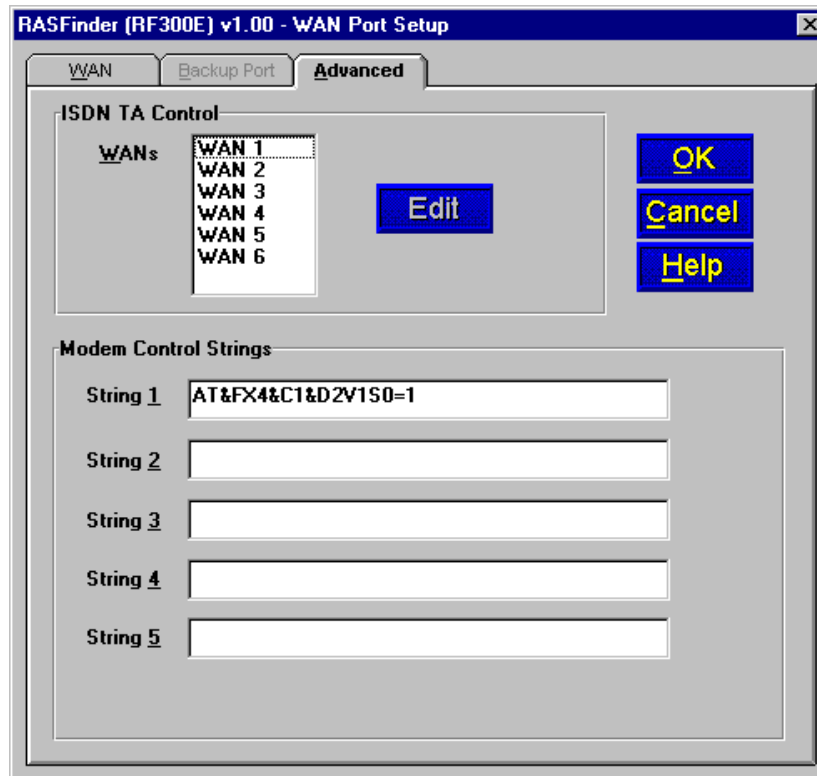
The **Script** button provides access to the scripting options. The **Script Dialog** menu enables you to edit, compile and download scripts. A script file (a text file containing a sequence of commands; refer

to Appendix B) can be used to automate certain RASFinder operations. The **Script Enable** or **Restart Script On Communications Failure** option can be used to either start scripting or restart a script upon failure.

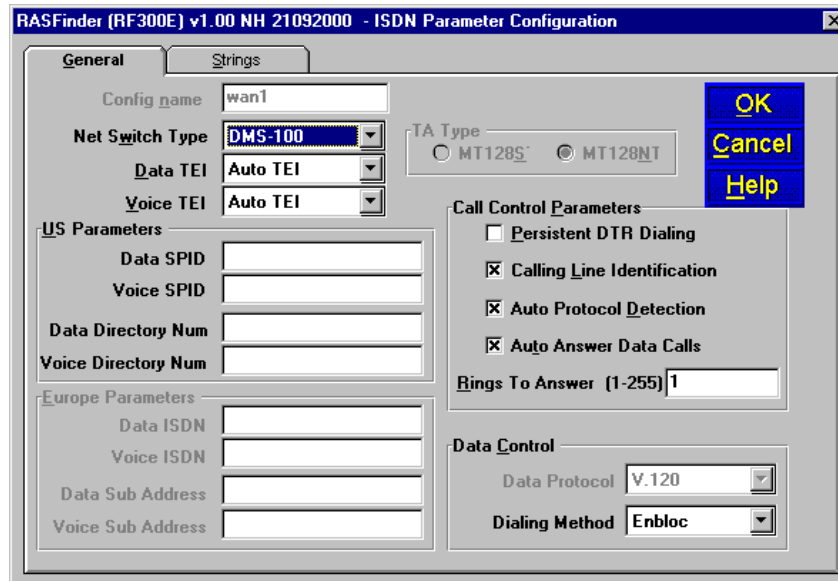
The RASFinder has built-in support for Multi-Tech Communication Services Interface Server (MCSI, NASI, NCSI, or AG server) if every asynchronous communication line across the internetwork has a unique MCSI name. If you set the Connection Method for **Answering**, the **Asynchronous Gateway Server (AG Server)** group becomes active, enabling you to set the General Name and Specific Name of the interface corresponding to that specific WAN Port. The name of the AG Server is assumed to be the same as the IPX router name (or at least the first eight characters of the Router Name entered on the Default Parameters dialog box during initial configuration). The **General Name** can be any 8 alphanumeric characters (with no question marks) and the **Specific Name** can be any 14 alphanumeric characters (with no question marks).

Setting the Connection Method for **Answering** also activates the Terminal Server group, where you need to enter, in the field provided, the dotted decimal IP Address of the default Telnet server.

From the **Advanced** tab, you can define the parameters for each WAN port, i.e., whether it is an ISDN parameter or a modem parameter. In defining the ISDN TA Control parameters, you highlight the WAN number and click on the Edit button. To define the modem parameters for the five out of six modems, you enter the modem string in the appropriate String number corresponding to the WAN port selected the Wan tab.



When you select the Wan port in the ISDN TA Control group and click on the Edit button, the ISDN Parameter Configuration dialog box is displayed with the Wan port number displayed in the Config name field. The Config name field is greyed out so that it can not be changed.



This dialog box displays the network switch type and the US Parameters or the Europe Parameters, depending on the switch type selected. In the first example (above), the *default* US Parameters are displayed and are available for editing purposes. The Net Switch Type is also unavailable as it is the switch type that was defined for this particular configuration.

## General Parameters

**Data TEI** (Terminal Endpoint Identifier) - You may have received a fixed TEI (a number from 0 to 63) from your provider; if so, then select that number from the list in the Data TEI box. However, if the central office switch assigns a dynamic TEI each time your RASFinder connects to the network, then leave it set to the default, "Auto TEI." If you have multiple RASFinders attached to a network terminator bus, you may want to set the Data TEI to "Disabled."

**Voice TEI** - You may have received a fixed TEI (a number from 0 to 63) from your provider; if so, then select that number from the list in the Voice TEI box. However, if the central office switch assigns a TEI each time your RASFinder connects to the network, then leave it set to "Auto TEI." Again, if you have multiple RASFinders attached to a network terminator bus, you may want to set the Voice TEI to "Disabled."

## US Parameters

The US Parameters group includes the Data SPID, Voice SPID, the data Directory Number (DN), and the voice DN. The SPIDs and Directory Numbers may not be required by your service provider; but, if they are required, the fields are defined below.

**Data SPID** (Service Profile Identifier) - Enter the Data SPID, if required, that was assigned by the local phone company for the specific BRI line to which the RASFinder is attached. The Data SPID string can have up to 20 characters. For DMS-100 switches, any ASCII character except the underline ( ) is valid; For NI-1 and AT&T switches, only the digits 0-9 are valid.

**Voice SPID** - Enter the Voice SPID, if required, that was assigned by the local phone company for the specific BRI line to which the RASFinder is attached. The Voice SPID string can have up to 20 characters. For DMS-100 switches, any ASCII character except the underline ( ) is valid; For NI-1 and AT&T switches, only the digits 0-9 are valid.

**Data Directory Number (DN)** - The data DN is a telephone number the ISDN service provider assigns, if required, to the RASFinder at subscription time; this can be a string of up to 24 characters. Valid characters are 0-9, the \* character, and the # character.

**Voice DN** - The voice DN is a telephone number the ISDN service provider assigns, if required, to the RASFinder at subscription time; this can be a string of up to 24 characters. Valid characters are 0-9, the \* character, and the # character.

## European Parameters

The Europe Parameters group includes the Data ISDN, Voice ISDN, the Data Sub Address, and the voice Sub Address. The Data and Voice ISDNs and Sub Addresses may not be required by your service provider. If the ISDNs and Sub Addresses are required, the fields are defined below.

**Data ISDN** - Enter the Data ISDN, if required, that was assigned by the local phone company for the specific BRI line to which the RASFinder is attached. The Data ISDN string can have up to 20 characters. If the switch type is NET3, the Data ISDN is not used.

**Voice ISDN**- Enter the Voice ISDN, if required, that was assigned by the local phone company for the specific BRI line to which the RASFinder is attached. The Voice ISDN string can have up to 20 characters. If the switch type is NET3, the Voice ISDN is not used.

**Data Sub Address** - The Data Sub Address is a telephone number the ISDN service provider assigns, if required, to the RASFinder at subscription time; this can be a string of up to 24 characters. Valid characters are 0-9, the \* character, and the # character.

**Voice Sub Address** - The Voice Sub Address is a telephone number the ISDN service provider assigns, if required, to the RASFinder at subscription time; this can be a string of up to 24 characters. Valid characters are 0-9, the \* character, and the # character.

## Call Control Parameters

**Persistent DTR Dialing** - Data Terminal Ready (DTR) normally goes high when a communication program starts or is ready to dial. A high DTR on the serial port indicates that your computer or terminal is ready to communicate with the RASFinder. The Persistent DTR Dialing function built into the RASFinder enables the RASFinder to automatically redial the telephone number of the ISDN service provider whenever DTR is high and there is no active call on the serial port. You can either enable or disable this feature (the default for this function is “disabled” or unchecked).

**Note:** You can use the key combination, “Alt-P” to check or uncheck this function.

**Calling Line Identification (CLI)** - When you check this function, the RASFinder identifies (for ISDN data calls only) whether the two endpoints of a connection are enabled or disabled for the purposes of RING messages. If the Calling Party Number is included in the incoming SETUP message for a given call, the RING message will display it, together with the Called Party Number, in the following format: “FM: 5552000 TO: 5551000.” If the Called Party Number is not included in the SETUP message, the RING message will show only the Calling Party Number as follows: “FM: 5552000.” If neither number is included, the RING message will contain no additional information. The default for this parameter is “enabled” or checked.

**Note:** you can use the key combination of “Alt-D” to check or uncheck this function.

**Auto Protocol Detection** - You should leave this function disabled (unchecked) because we set the Data Protocol in the Data Control group to “MLPPP” and do not use any of the other protocols listed there.

**Auto Answer Data Calls** - You can enable this function if you want your RASFinder to answer automatically all incoming data calls (this option does not affect the analog port). If you do enable the Auto Answer function, you should also set the Rings To Answer function unless you want to leave it at the default selection which is one ring before it answers. (Selecting either “0” or “1” causes it to answer after the first ring.)

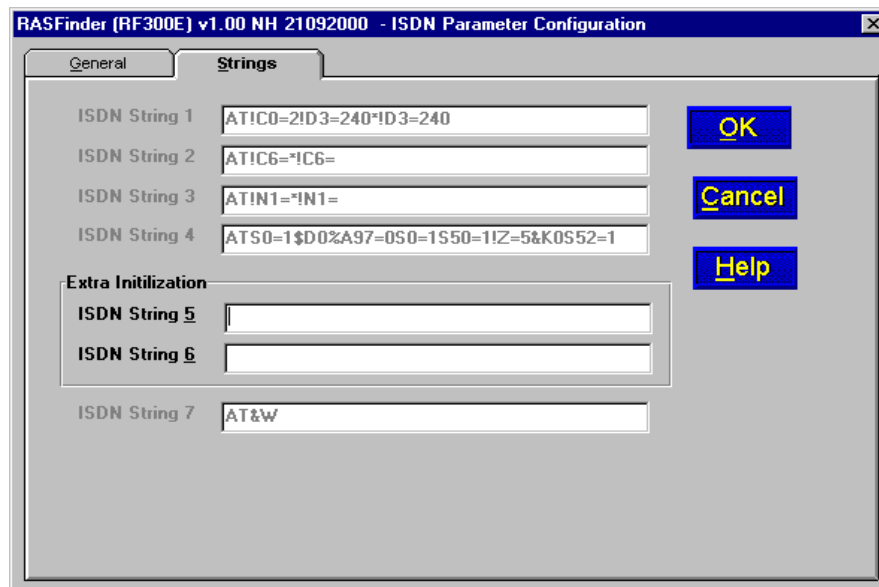
## Data Control

**Data Protocol** - As mentioned above (in **Auto Protocol Detection**), we leave this function set to MLPPP, which uses both B channels (each at rates of up to 64 Kbps per channel) providing an aggregate data transmission speed of 128 Kbps, maximum.

**Dialing Method** - The default is “Enbloc,” which is used for most ISDN dialing; however, if your RASFinder is on a private network you can switch to the “Overlap” dialing method for establishing a data call on the ISDN line.

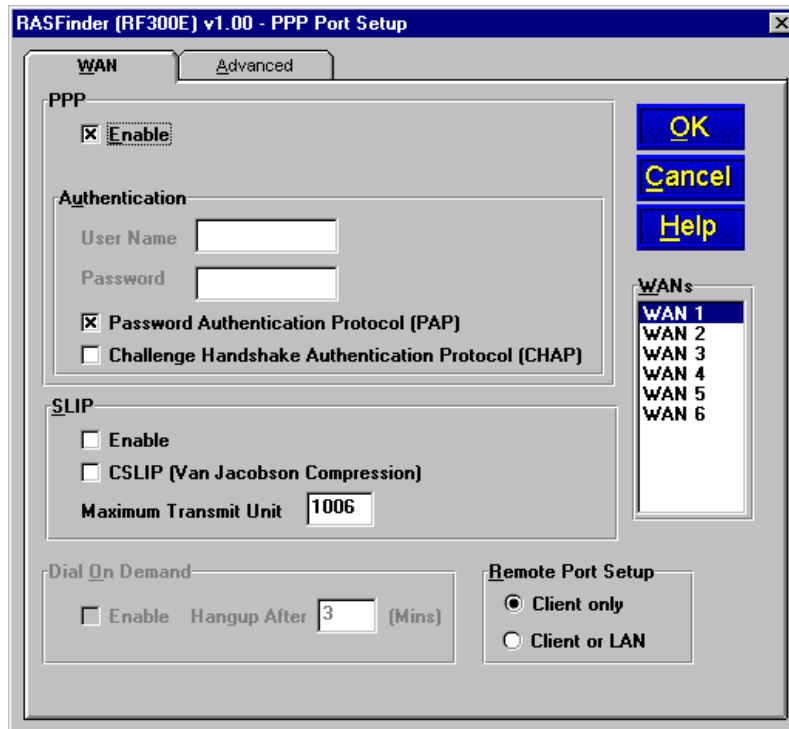
## Strings

The Strings dialog box allows you to add additional initialization commands for your ISDN configuration. The AT commands for your ISDN String are found in Attachment D of this User Guide.



## Point-to-Point Setup

The **PPP Port Setup** dialog box controls the WAN port protocol, dial on demand, and remote port setup. The WAN port protocol can be either Point-to-Point Protocol (PPP) or Serial Line Internet Protocol (SLIP). Of these two protocols, PPP is the more robust as it enables the endpoints to negotiate the use of the link and protocol parameters in a standardized way and also enables for standardized encapsulation of the packets. SLIP is an older protocol which requires manual authentication using a script.



**PPP** is the default protocol. The PPP software in the RASFinder internally negotiates the use of a suitable authentication protocol (PAP or CHAP) with the remote router or remote access client software. When either PAP or CHAP (or both) is enabled, the RASFinder expects the peer (the client on the other side of the WAN link) to be configured with a User Name and Password combination that is in the RASFinder's User Database. The User Name and Password are both ASCII character strings that can be up to 30 characters long. However, for router-to-router connections, authentication is normally not used and the User Name and Password fields are empty.

If SLIP is to be used on one of the WAN ports, then select the SLIP Enable option on the corresponding tab and PPP will be disabled automatically. If the TCP/IP header is to be compressed using VJC compression, then check the **CSLIP (Van Jacobson Compression)** option. (Note: on answering WAN ports, the RASFinder can detect the type of connection -- PPP or SLIP.)

You can set up the RASFinder to bring down the connection on the WAN link when there is no real data traffic on the line; the router will then automatically bring up the WAN link when data is available to go across the link.

In the **Remote Port Setup** group, the **Client only** option saves IP addresses in a RAS application because the remote node (a dial-in client) becomes a virtual extension of the Ethernet LAN. For Routing, however, you must check the **Client or LAN** option, in which case there will be no saving of IP addresses on the WAN ports.

## Applications

In addition to local configuration, the RASFinder supports various applications that enable remote viewing and changing of the configuration from anywhere on the connected internet network. To manage these applications, click **Others** on the **Router Setup** menu.

The **Applications Setup** dialog box appears.

Verify that the desired applications are enabled (checked). The default condition is all applications are checked. To disable a given application, click to uncheck the check box and disable support.

For more information on using these remote configuration applications, click the on-line **Help** button or refer to Chapter 7, Remote Configuration and Management.

## Diagnostics

The RASFinder is equipped with a built-in diagnostics utility that can be accessed by a PC cabled directly to the command port (remote users cannot access the diagnostics). Click the **Built-in Test** button on the **Router Setup** menu and the **Diagnostics** dialog box is displayed.

In the **Test Port** group, select the either the WAN or Ethernet button you want to test. If you choose the WAN button, you can then select a specific WAN port to test by highlighting the WAN number in the drop down window. Click the Test button to start the test.

For additional details and parameters about specific fields in the **Diagnostics** dialog box, click the on-line **Help** button.







## Chapter 5 - Client Setup



## Introduction

The information provided in this chapter enables multiple users to configure their PCs to access the LAN through a RASFinder. The procedures are divided into two sections, based on operating platform. The first section covers configuration of Windows 98/95 PCs, and the second section covers configuration of Windows NT (4.0 Workstation) PCs.

## Before you Begin

Before you begin the client setup process, read through the following requirements:

### RASFinder

The RASFinder was configured by the administrator who, while installing the software, determined that the RASFinder would either automatically assign Internet (IP) addresses, or require that they be assigned manually to each client PC. Also, the administrator assigned an IP address to the RASFinder's Ethernet port, and assigned user names and passwords to the WAN links. All these factors play a role in client configuration. Make certain that you are aware of the decisions made prior to setting up client PCs.

### PC

To access the RASFinder, your PC must have communications capability including hardware such as a Dial Up Network Adapter/modem and any necessary software.

Make certain that your Dial Up Network Adapter IP addressing is dynamically assigned (default). If it is, then the only information you may be required to obtain is the IP address of your organization's Domain Name Server (DNS) - if DNS has been enabled on the **IP Setup** dialog box, Advanced tab.

**Note:** In cases where the IP address has been manually assigned, you will need to know the IP address of the RASFinder (Gateway address) in addition to the organization's Domain Name.

### Checklist

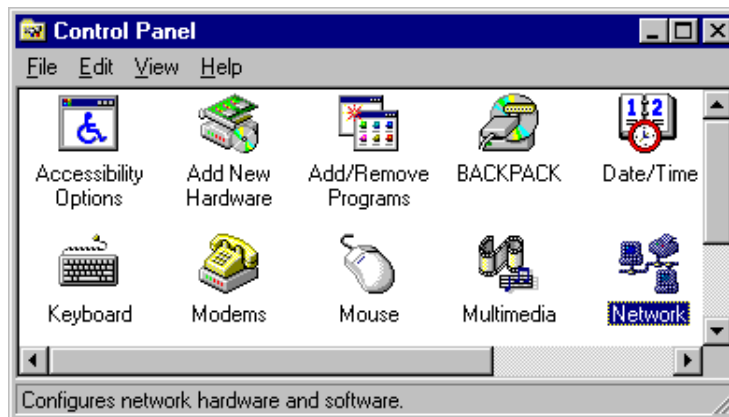
A checklist has been provided towards the end of each procedure (Step 16). This checklist is included in the setup so that you can record all the pertinent information required for the connection between your PC and the RASFinder. Keep this as a reference for future upgrades.

## Configuring in Windows 98/95

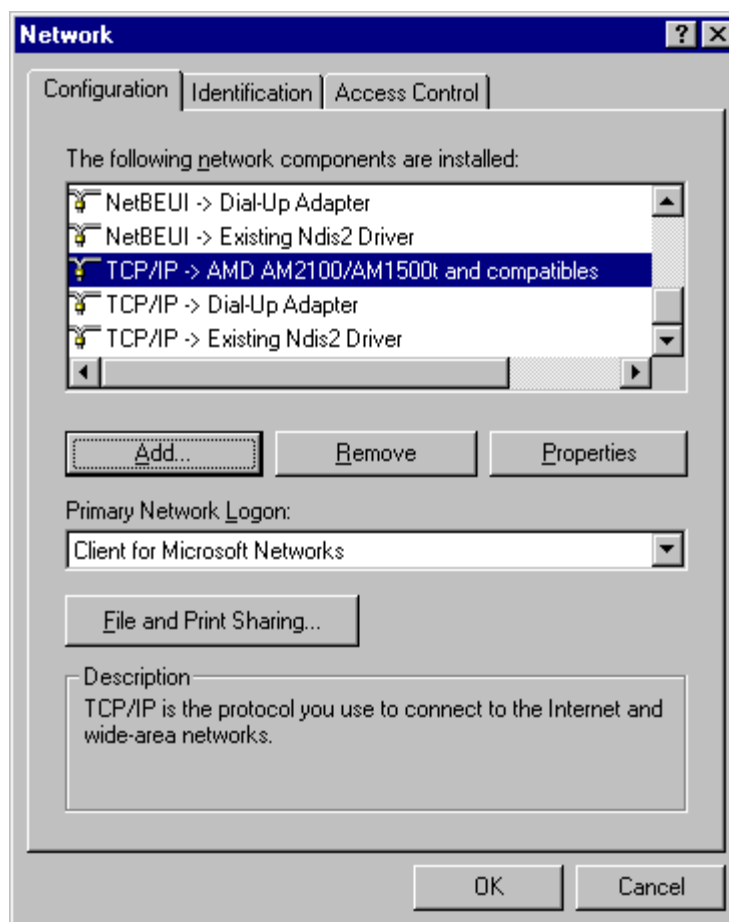
Perform the following steps to set up your Windows 98/95 PC:

**Note:** All of the hardware and screens used in this section are intended as examples only. Please select options appropriate to your system.

1. Click **Start | Settings | Control Panel** and then double click the **Network** icon.

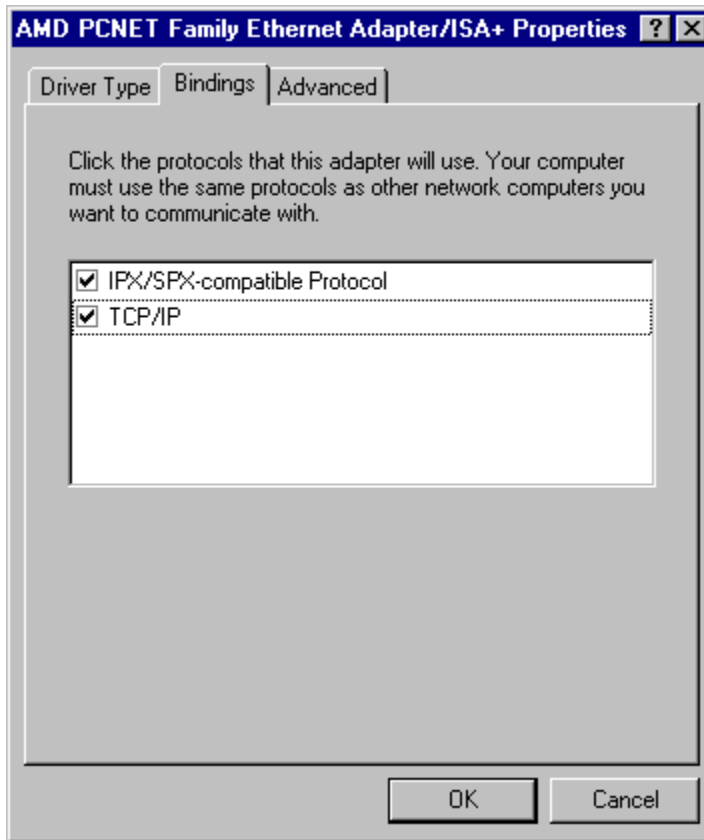


The **Network** dialog box (**Configuration** tab) is displayed which shows all the components (i.e., clients, adapters, protocols, and any services) installed on your PC.



2. If **TCP/IP** is listed, proceed to step 3; otherwise, refer to **Installing TCP/IP (Win98/95)**, at the end of this section.

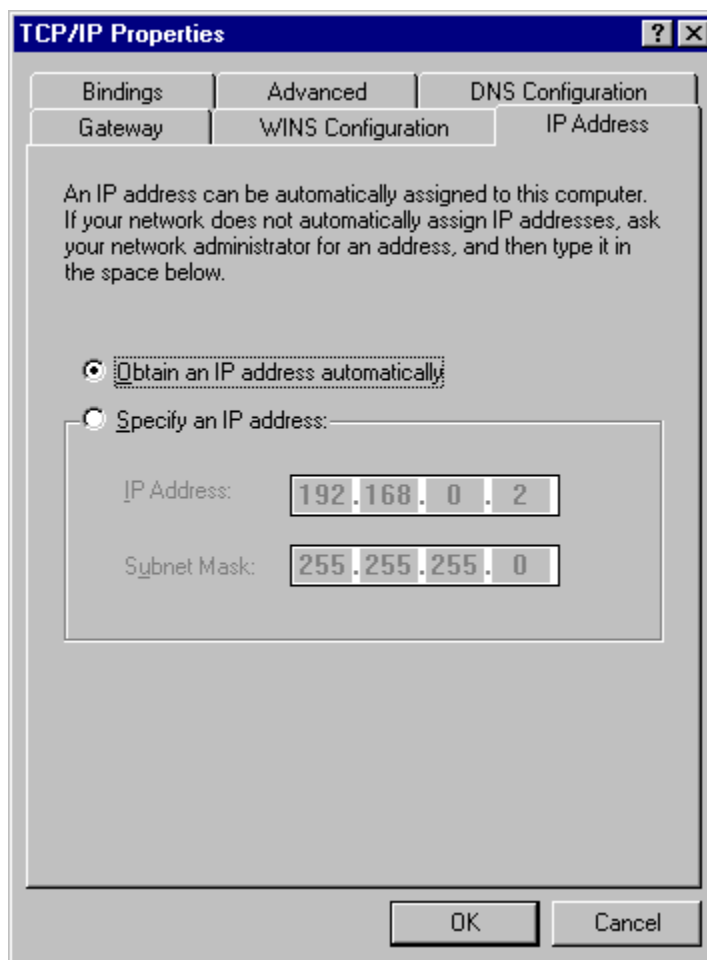
3. Check for binding between the adapter and TCP/IP. In the **Network** dialog box, click your Ethernet adapter to select it, then click **Properties** to display the Adapter Properties window.



4. Click the **Bindings** tab, then if necessary click the box to the left of TCP/IP so this entry is enabled (checked). When you are finished, click **OK** to return to the **Network** dialog box.

**Note:** There may be other protocols listed and enabled under your Ethernet adapter. This does not affect the TCP/IP protocol. Rather, it simply means your computer will accept messages using those protocols as well as TCP/IP.

5. Select **TCP/IP**, then click **Properties** to open the **TCP/IP Properties** window.



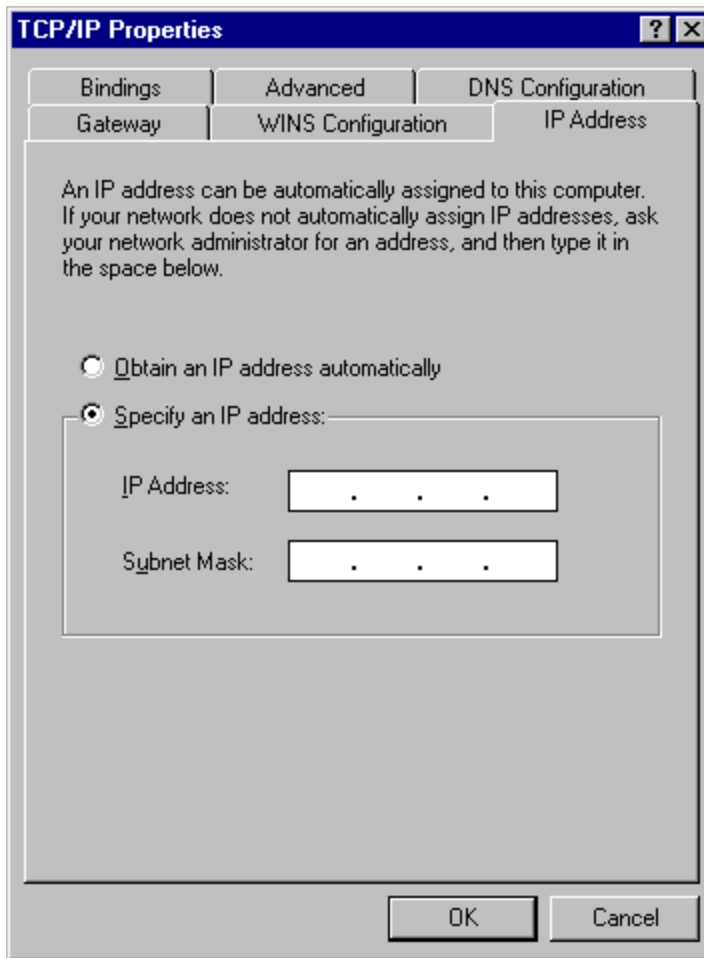
6. Select the **IP Address** tab.

The IP addressing method depends on how your RASFinder's DHCP Server option was configured. If DHCP Server is active, your IP address is issued automatically from an external DHCP server located on the LAN. If your network administrator did NOT activate DHCP Services on the RASFinder, the IP address assigned to the client will be the same as the WAN's remote IP address or may be assigned by a Radius server.

Verify the RASFinder/DHCP status with your network administrator, then proceed to step 7 for DHCP assigned addressing, or to step 8 for manual addressing.

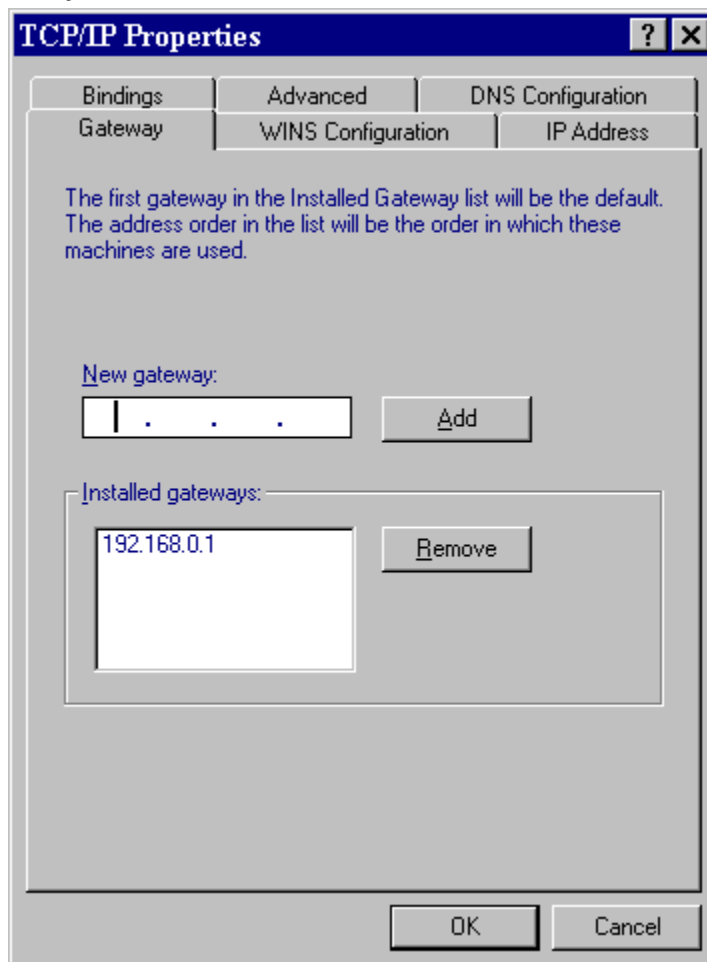
**Note:** The RASFinder Dynamic Host Configuration Protocol (DHCP) option is enabled on the **IP Port Setup, Advanced** tab.

7. If DHCP Services are active on the RASFinder (default), verify that the **Obtain an IP address automatically** option is selected. You are done; go to step 17 to reboot your PC and attempt to open an Internet session.
8. If DHCP Services are NOT active on the RASFinder, you may be required to manually enter your IP address. In most cases, dynamically assigned addressing is the best alternative. The only exception would be if only one specific WAN port is accessed or if Radius is assigning an IP address based on the user logging into the Radius server. Select manual addressing by clicking the **Specify an IP address** option. The IP Address and Subnet Mask fields become active.



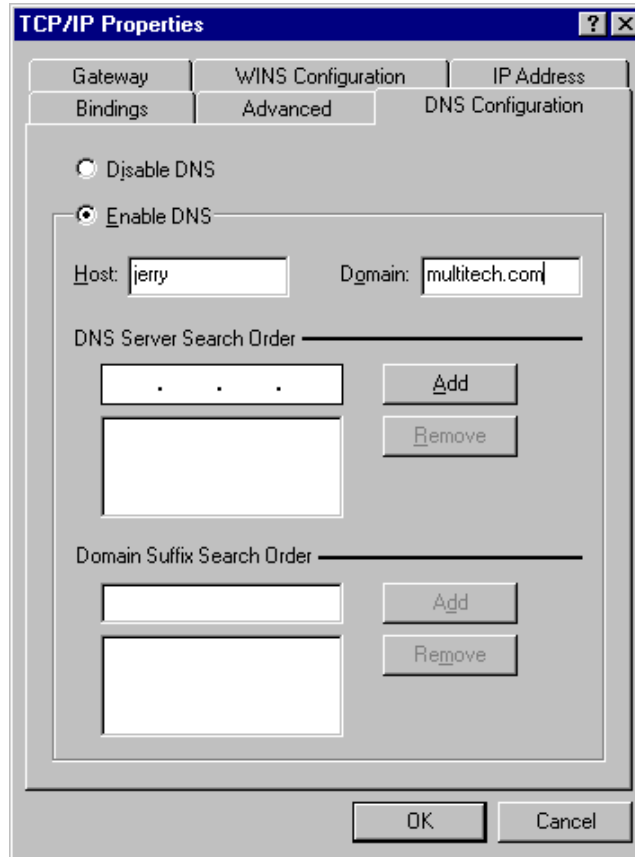
Remove the default IP address (if any) and begin typing the new address. This address is entered in dotted decimal notation and is comprised of four groups (octets) separated by periods or “dots.” If a group has fewer than 3 digits, type the necessary digits and press the space bar to move to the next group. When you are finished, verify that the IP address is identical to the IP address you were given for your PC.

10. Click the **Gateway** tab.



11. In the **New gateway** field, enter the IP address of the RASFinder's Ethernet port and click **Add**. The new gateway address is displayed in the list of **Installed gateways**.

- Click the **DNS Configuration** tab. Verify that **Enable DNS** is selected (checked).



- In the **Host** field, enter your user name (e.g., jerry).
- In the **Domain** field, enter your company's domain name (usually the company name followed by one of the following extensions: .com, .edu, .gov, .org, .mil, or .net. For example, multitech.com).
- In the **DNS Server Search Order** group, place the cursor in the first group of the address field and type the IP address of your LAN's DNS server (provided by your network administrator). Click **Add** and the new address is displayed in the list below the address field.

Your network may have more than one DNS server, allowing you to use a secondary DNS server if the primary DNS server is not available. If this is the case, add the IP address of the secondary DNS server using the same procedure as with the first.

**Note:** The address that is displayed first (at the top) of the list is the primary server (the first one searched). You can "drag and drop" the items in the list, if necessary, until the primary DNS server is listed first.

When this is done, click **OK**. You are returned to the **Network** dialog.

- In the **Network** dialog box, Click **OK**. You are returned to the **Control Panel**.

Use the following checklist to record all the configuration settings for future use:



Configuration Checklist	
IP Address (PC)	. . .
IP Address (RASFinder)	. . .
Host (User Name)	
Domain	
DNS Server Address	. . .
Network Adapter (Manufacturer/Model Number)	

17. Reboot the PC for changes to take effect.

At this point your client setup is complete. Test your setup by following steps 18 and 19. If you encounter problems, contact your administrator.

18. Initiate an Internet session by double-clicking on your browser icon, or try to FTP a file.

**Note:** The RASFinder operates transparently, so there should not be a need for any special settings on your IP applications (i.e., browser, Telnet, or FTP).

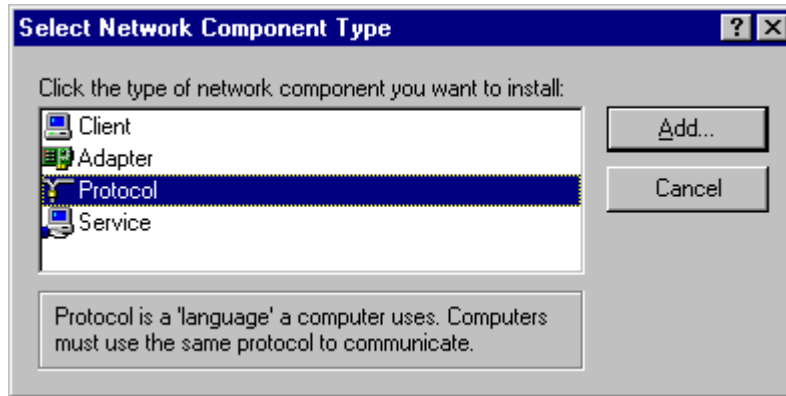
19. To further validate your connection to the RASFinder, "Ping" the IP address of the RASFinder.

## Installing TCP/IP (Win98/95)

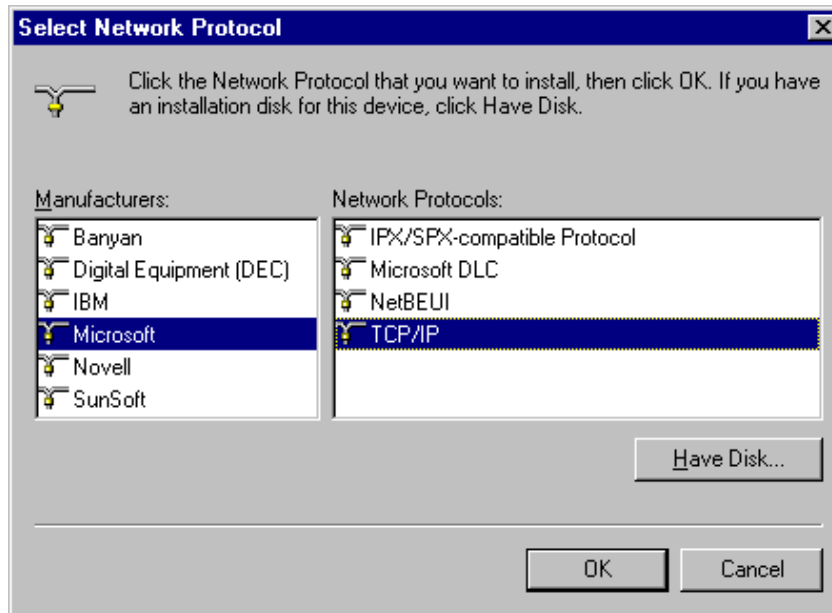
If TCP/IP is not already installed, perform the following steps:

**Note:** For this procedure you may need your Windows installation disks or CD ROM.

1. In the **Network** dialog box, click **Add**. The **Select Network Component Type** dialog box is displayed with a list of installation options.



2. Select **Protocol** and click **Add**. The **Select Network Protocol** dialog box is displayed with protocol options.



3. In the **Manufacturers** list click the manufacturer option (Microsoft in the example) to highlight it. A list of available protocols will appear in the **Network Protocols** list.
4. In the **Network Protocols** list, select **TCP/IP** and click **OK**.
5. Exit the add option. Click the **OK** button.

**Note:** If Windows does not find the necessary files on the hard drive, click **Have Disk** and follow the on-screen instructions for loading TCP/IP from the installation disks/CD-ROM.

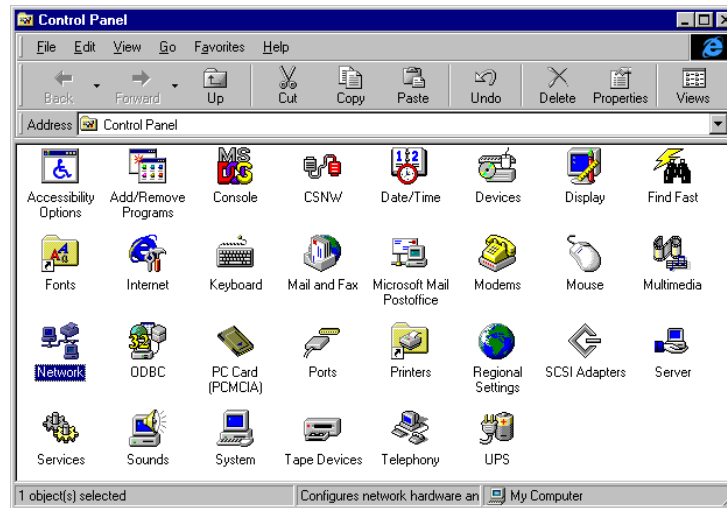
6. Reboot your PC for changes to take effect.
7. Click **Start | Settings | Control Panel** and double-click the **Network** icon to return to the **Network** dialog box. Return to step 3 of the **Configuring in Windows 98/95** and continue with the client setup procedure.

## Configuring in Windows NT

Perform the following steps to set up your Windows NT workstation PC:

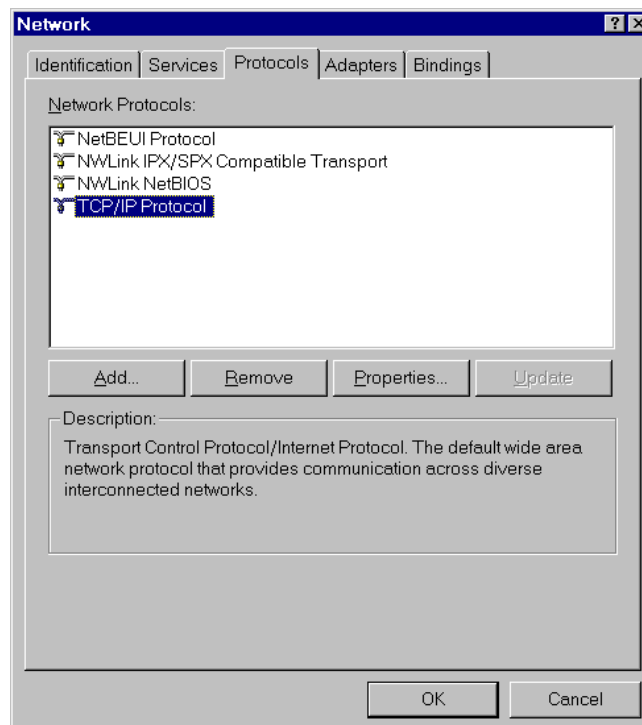
**Note:** All of the hardware and screen samples in this section are intended as examples only. Please select options appropriate to your network.

1. Click **Start | Settings | Control Panel**.



Double click the **Network** icon.

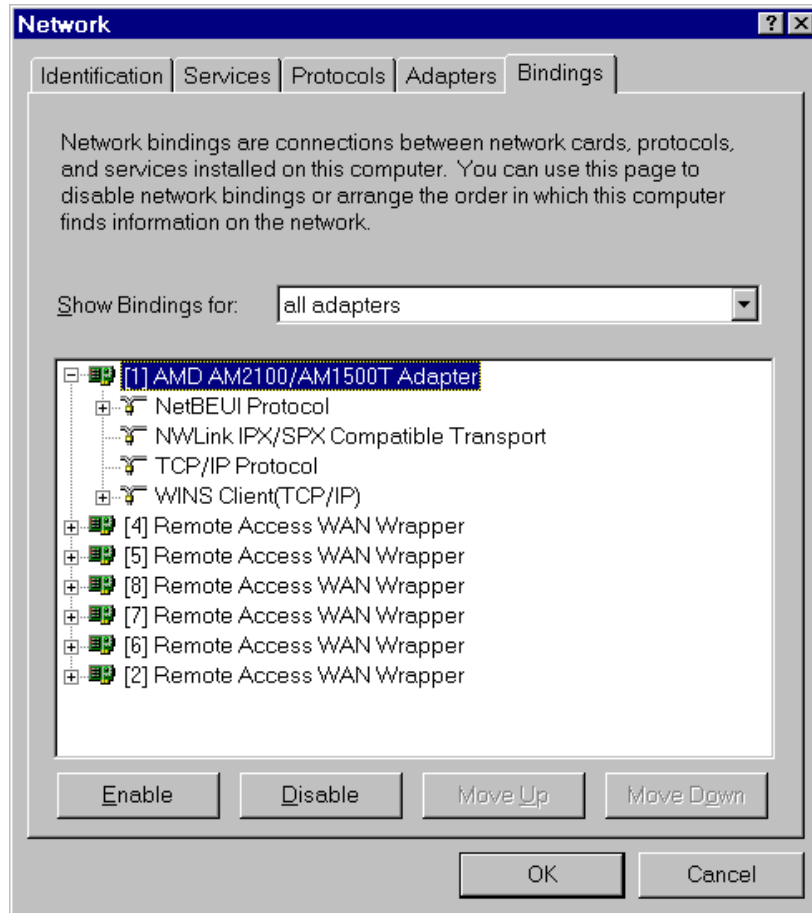
2. The **Network** dialog box is displayed. Click the **Protocols** tab.



A list of protocols currently present on your PC is displayed. Check the installed protocols. If you find **TCP/IP Protocol** listed, proceed to step 4. If TCP/IP is not listed, you must install it prior to proceeding. Refer to **Installing TCP/IP (WinNT)** at the end of this section.

Click the **Bindings** tab.

3. The **Bindings** tab is displayed.

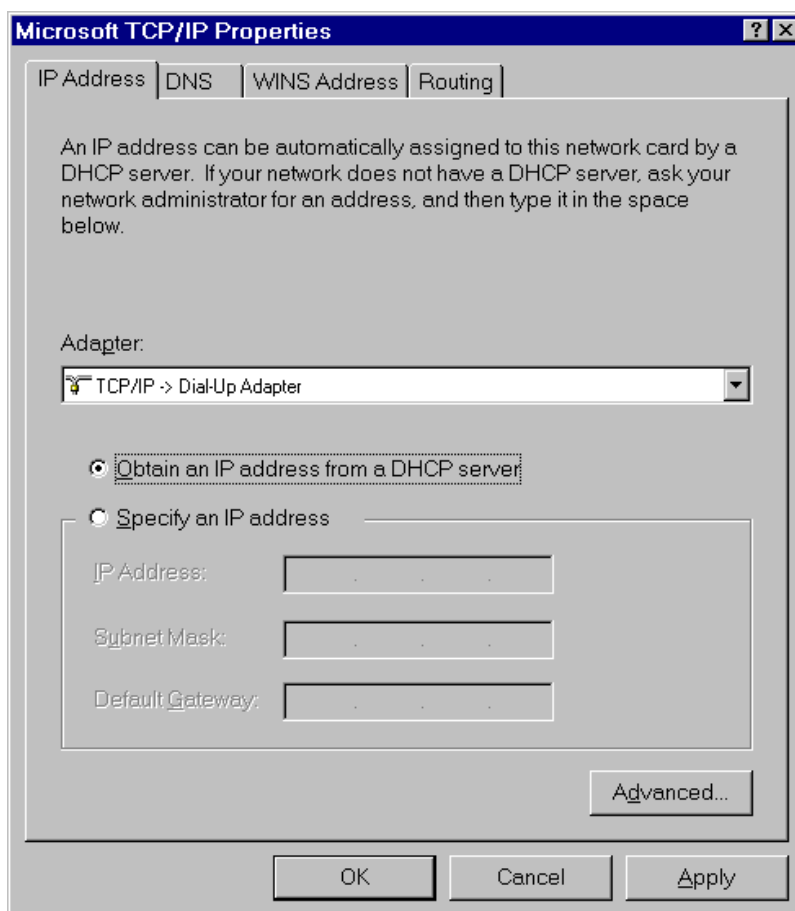


4. In the **Show Bindings for** drop down list, select **all adapters**. A list of all adapters is displayed.
5. Double click the entry for your Ethernet card adapter to expand the list of bindings. Verify that **TCP/IP Protocol** is included in the bindings below your adapter.

**Note:** There may be other protocols in the list under your Ethernet adapter. This does not affect the TCP/IP protocol. Rather, it simply means your computer will accept messages using those protocols as well as TCP/IP.

6. Click the **Protocols** tab.

- In the **Network Protocols** list select **TCP/IP**, then click **Properties**. The **Microsoft TCP/IP Properties** dialog box is displayed.

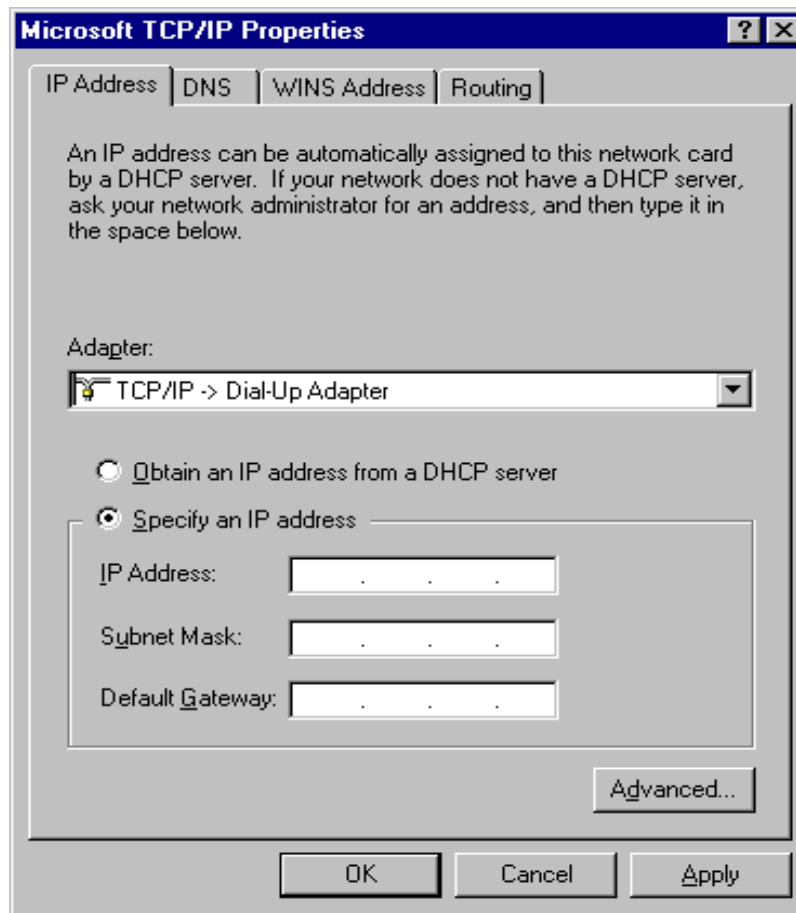


- Click the **IP Address** tab.

The IP addressing method depends on how your RASFinder's DHCP Server option was configured. If DHCP Server is active, your IP address is issued automatically. If your network administrator did NOT activate DHCP Services on the RASFinder, you will have to assign your IP address manually.

Verify the RASFinder/DHCP status with your network administrator, then proceed to step 9 for DHCP assigned addressing, or to step 10 for manual addressing.

- If DHCP Services are active on the RASFinder (the default), verify that the **Obtain an IP address from a DHCP server** option is enabled (checked). At this point, you are done. Go to step 20 and attempt to open an Internet session.
- If DHCP Services are NOT active on the RASFinder, you may have to manually enter your IP address. Select manual addressing by clicking the **Specify An IP Address** option. The IP Address and Subnet Mask fields become active.

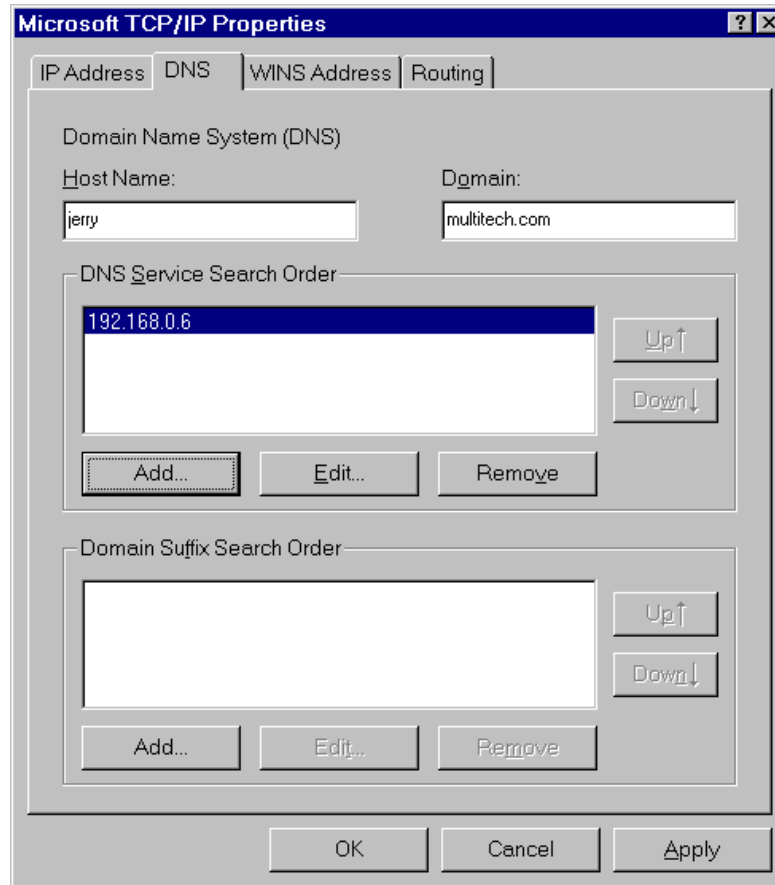


11. In the **IP Address** field, type the IP address assigned to your PC.

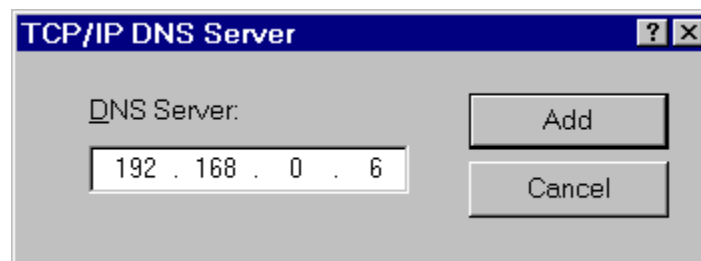
Remove the default IP address (if any), and begin typing the new address. This address is entered in dotted decimal notation and is comprised of four groups (octets) separated by periods or "dots." If a group has fewer than 3 digits, type the necessary digits and press the space bar to move to the next group. When you are finished, verify that the IP address is identical to the IP address you were given for your PC.

12. In the **Subnet Mask** field, type the subnetwork mask assigned by your administrator. When you are finished, verify the new mask.
13. In the **Default Gateway** field, type the IP address of the gateway assigned to your LAN. When you are finished, verify the new gateway.

14. Click the **DNS** tab. The **Domain Name System (DNS)** properties are displayed.



15. In the **Host Name** field, type your user name (e.g., jerry).
16. In the **Domain** field, enter your company's domain name (usually the company name followed by one of the following extensions: .com, .edu, .gov, .org, .mil, or .net. For example, multitech.com).
17. In the **DNS Server Search Order** group, click **Add**. The **TCP/IP DNS Server** dialog box is displayed.



18. In the **DNS Server** field, place the cursor in the first group and type the IP address of your LAN's DNS server (provided by your network administrator).
19. Click **Add**. You are returned to the **Microsoft TCP/IP Properties** dialog box, **DNS** tab, and the new address is displayed in the **DNS Search Order** list.

Your network may have more than one DNS server, allowing you to use a secondary DNS server if the primary DNS server is not available. If this is the case, add the IP address of the secondary DNS server using the same procedure as with the first.

**Note:** The address that appears first (at the top of the list) is the primary server (the first one searched). You can use the **Up** and **Down** buttons to rearrange the items in the list, if necessary,

until the primary DNS server is listed first.

When this is done, click **OK**. You are returned to the **Network** dialog box.

Use the following checklist to record all the configuration settings for future use:

Configuration Checklist	
IP Address (PC)	. . .
IP Address (RASFinder)	. . .
Host (User Name)	
Domain	
DNS Server Address	. . .
Network Adapter (Manufacturer/Model Number)	

20. Reboot the PC for changes to take effect.

At this point your client setup is complete. Test your setup by following steps 21 and 22. If you encounter problems, contact you administrator.

21. Initiate an Internet session by double-clicking your browser icon, or try to FTP a file.

**Note:** The RASFinder operates transparently, so there should not be a need for any special settings on your IP applications (i.e., browser, Telnet, or FTP).

22. To further validate your connection to the RASFinder, “Ping” the IP address of the RASFinder.

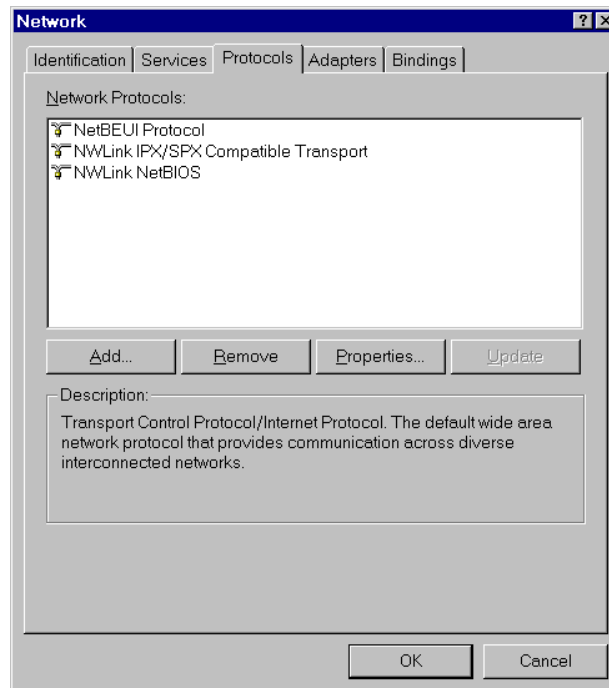


## Installing TCP/IP (WinNT)

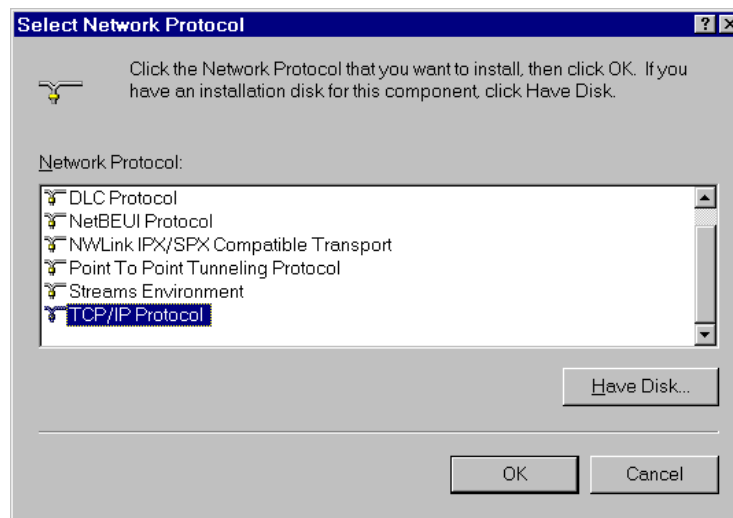
If TCP/IP is not already installed, perform the following steps:

**Note:** For this procedure you may need your Windows NT installation CD ROM.

1. While the **Network** dialog box is open, click **Add**.



2. The **Select Network Protocol** dialog box is displayed with a list of available protocol options.



Highlight **TCP/IP Protocol** and click **OK**.

If necessary (i.e., the operating system does not find the necessary files on the hard drive), click the **Have Disk** button, then follow the instructions provided on-screen.

3. You are returned to the **Network** dialog box.
4. Reboot your PC for changes to take effect.
5. Open the Control Panel and double-click the Network icon to return to the Network Configuration window, then go to step 4 of the **Configuring Windows NT** procedure.





## Chapter 6 - RAS Dial-Out Redirector



## Introduction

Multi-Tech's Remote Access Server for Microsoft network users enables users to dial-out and fax-out through your RASFINDER. Remote Access Solution software uses Multi-Tech's Communications Services Interface (MCSI - pronounced "Mik-see"). MCSI is a software redirector which complies with MCSI/NCSI/NASI defacto standards for software redirection.

The Windows® version of MCSI, called WINMCSI, is supported on Windows 98/95 and Windows NT platforms. Since WINMCSI provides data communications connectivity, it needs to be installed and operating before your data communications application software is started.

## Installing and Configuring the WINMCSI Modem-Sharing Software

The WINMCSI modem-sharing software (included on the CD) manages access to an Asynchronous Gateway (AG) for outbound calls. It allows Windows communications software packages that do not support INT6B or INT14 to connect to a gateway. It also detects other compatible communications servers (e.g., RASs) on your network and displays the resources they provide to eligible LAN users.

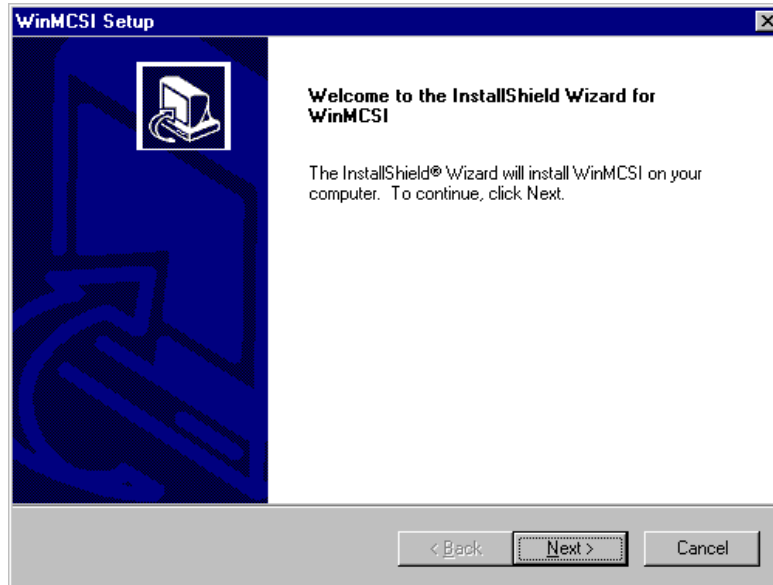
To install WINMCSI in Windows 98/95 or Windows NT, follow the steps below:

**Note:** Faxing through WINMCSI is only supported on modems using Lucent chipsets. If you are not certain as to the type of chipset in the internal modem, contact Multi-Tech Systems Technical Support.

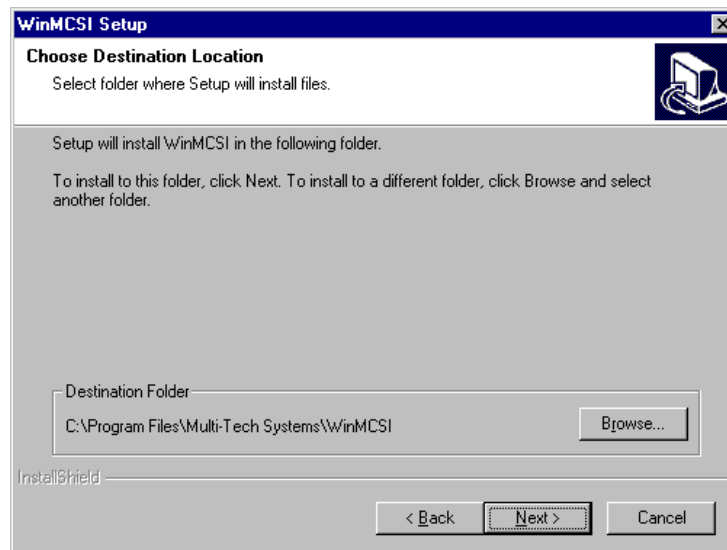
1. Power on your client PC and log in to your LAN.
2. Start Windows.
3. Insert the Multi-Tech RASFinder CD into your CD-ROM drive. The **RASFinder AutoRun** screen is displayed.
  - Close the **RASFinder AutoRun** screen.
  - Double-click your **My Computer** icon.
  - Right-click the CD-ROM drive icon.
  - Click **Open**. The **wsredir** folder contains two folders; one for Windows 9X operating systems (**Mcsi95**) and a second folder for Windows NT operating systems (**Mcsint**).
4. For Windows 9X users, choose **Mcsi95**, double-click on **Disk 1**, and then click on the **Setup.exe** icon.

For Windows NT users, choose **Mcsint**, double-click on **Disk 1**, and then click on the **Setup.exe** icon

The **WinMCSI Setup** dialog box is displayed with the Welcome message.

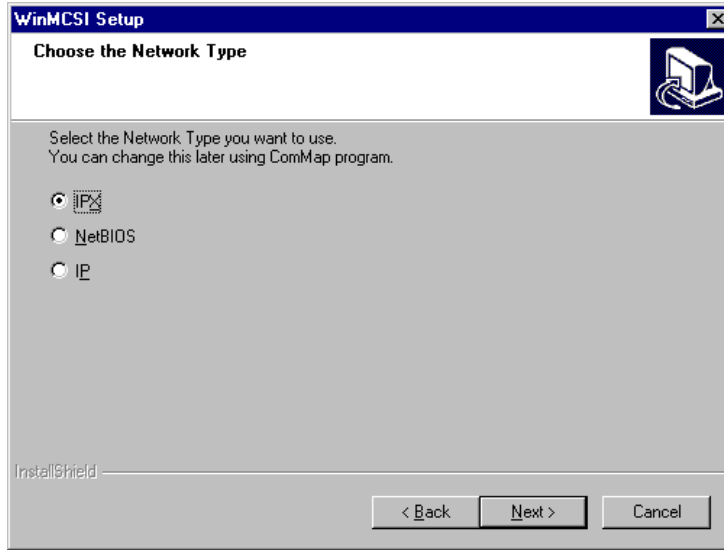


5. Click **Next** to continue.
6. The Choose Destination Location dialog box is displayed.



You can either choose the default Destination Location for your WinMCSI software by clicking **Next>**. If you click **Browse**, you can select a different destination folder for WinMCSI.

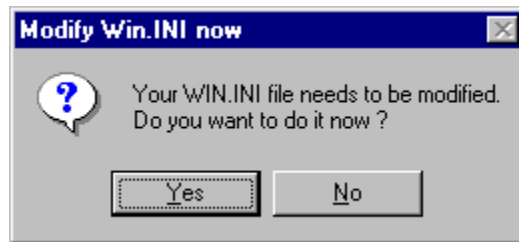
7. The Choose the Network Type dialog box is displayed.



For Win9X Operating Systems, you can choose from three network types. For Windows NT Operating System you choose either IP or IPX protocol.

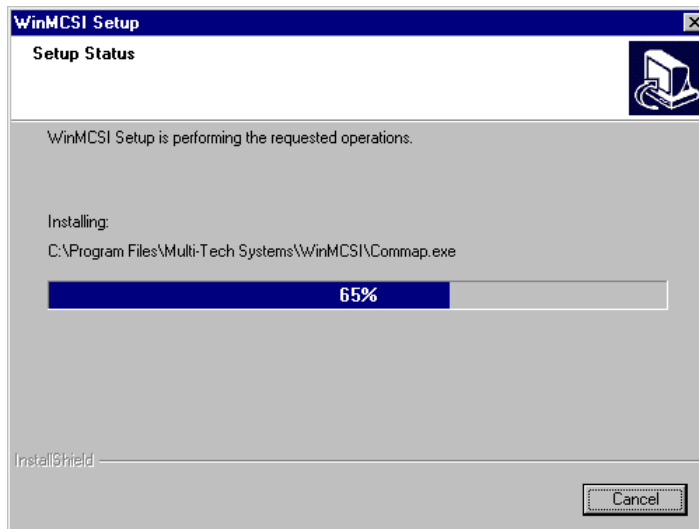
Choose your operating system protocol and click **Next** to continue.

8. The Modify Win.INI now dialog box is displayed for Win9X operating systems only.



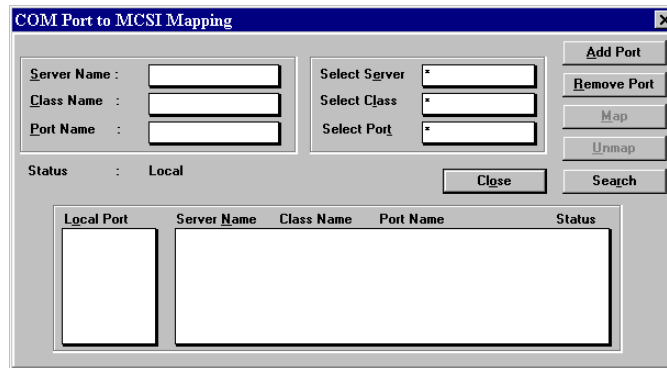
Click Yes to have WINMCSI automatically make changes to your Win.Ini files to have the operating system automatically load the utility upon startup.

9. Files are loaded on your system



8. The files are loaded onto your system and then the COM Port to MCSI Mapping window is displayed.

**Note:** If the **IP** option is selected, you will need to make a change to the ROUCON.INI file. Before making the change, make certain that the RASFinder software has been installed and is running. From a DOS prompt, change the directory location of the RASFinder 3.10 software and then edit the ROUCON.INI by changing the line "AG Network Interface To Use = 0" to "AG Network Interface To Use = 1". Once you've done this, save and download the changes.



Click **Add Port** to add a port to the **Local Port** list box.

If you want a specific line, click a COM port in the **Local Port** list box, then click the line to which you want to map that particular COM Port. The status message "Mapped to MCSI" should appear above the Local Port list box.

Click **Remove Port** to permanently remove a port from the **Local Port** list box.

Click the **Unmap** button if you want to unmap a line.

Click the **Search** button to search for lines on a server.

Click the **Close** button when finished.

At this time Your WINMCSI software installation is complete. Proceed to the next section, "Running the WINMCSI Workstation Software."

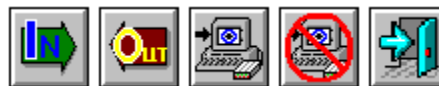
## Running the WINMCSI Workstation Software

WINMCSI has a workstation portion of the software that LAN users run and use to log onto the communications server prior to running datacomm software on their client PCs. The following steps guide you through this process.

1. Start **WINMCSI**, click **Start | Programs | MultiTech MCSI | ComMap**.
2. The **ComMap for Windows** window is displayed.



The buttons from left to right are: **Login**, **Logout**, **Map**, **Unmap**, and **Exit**.



3. To setup **ComMap**, click **Setup**.

Click the **Network Type** command. The **Network Type** dialog box is displayed. Your current network type is highlighted. You can change the network type by clicking the option button appropriate for your network. Click **OK** when finished. You must restart Windows if you change this setting.

**Note:** Do not change the network type unless you have changed the network. Also, make sure that your SYSTEM.INI file contains the device drivers specific to the selected network type.

Click the **Connect Timer** command. The **MCSI Connect Timer** dialog box is displayed. The default value of the connect timer is shown in the Enter Connect Timer Value field. To change the value of the connect timer, type in a different value. Click **OK** when finished.

Click the **Baud Change** command. The **ComMap Baud Change** message is displayed. If baud change by an application is permitted, then this command is checked in the Setup Menu. If baud change is unchecked in the Setup Menu, then an application cannot change the baud rate (or other port parameters). Answer the message appropriately.

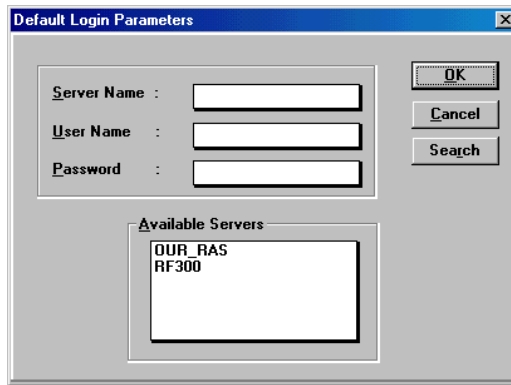
Click the **Default Login** command. The **Default Login Parameters** dialog box is displayed. Use this dialog box to select a specific RAS to which you want to log into next time Windows is loaded. Click a RAS from the **Available Servers** box. If there are no servers in the Available Servers box, then click the **Search** button. Type in a **User Name** and **Password** (optional) in their respective fields. Click **OK** when finished.

ComMap saves these login parameters in your COMMCSI.INI file.

**Note:** You cannot directly edit the COMMCSI.INI file using a text editor because the password field is encrypted.

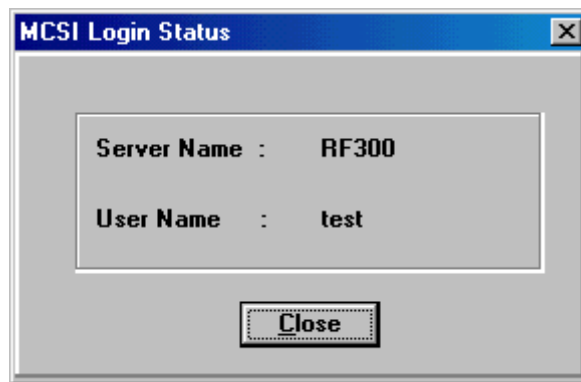
4. If you have not logged into the network, do so now by clicking **File | Login**, or click the **Login** button. The **MCSI Login** window is displayed.





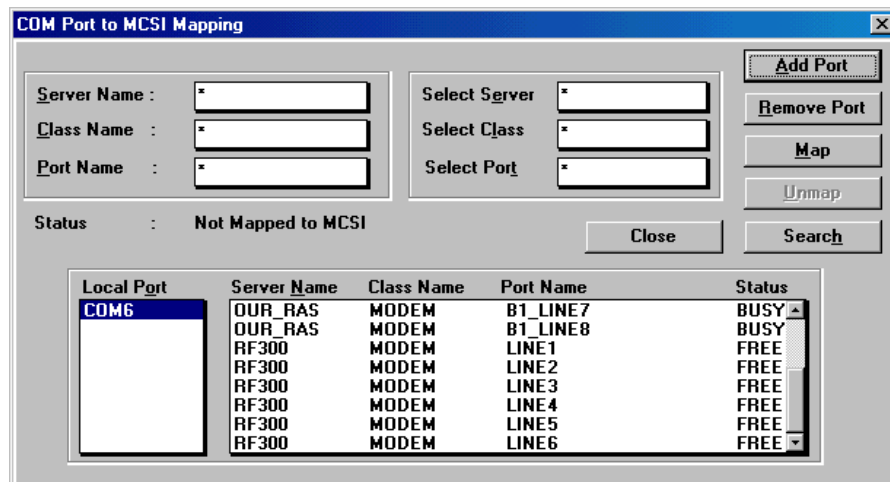
The **Available Servers** box lists the names of the available servers. Click the name of the server to which you want to attach, type a **User Name** and **Password** in their respective fields, and then click **Login**. A window is displayed stating that your login was successful. Click **OK**. If there are no servers listed in the **Available Servers** box, then click the **Search** button to search for a server.

- At the **ComMap for Windows** main window, view your log status by clicking **File | Log Status**. The **MCSI Login Status** window is displayed.



This window shows the name of the server to which you are logged in and the name with which you logged in. Click **Close** when you are finished.

- At the **ComMap for Windows** main window (to map a COM port through MCSI) click **Map | Map**. The **COM Port to MCSI Mapping** window is displayed.



**Note:** Windows 98/95 users will have two additional buttons in this box, the **Add Port** and the **Remove Port** buttons. You must click the **Add Port** button to view Local Ports. Click the **Remove Port** button to remove Local Ports.

If you want to get the first available line, click the **Map** button and then click the **Close** button and go to step 7.

If you want a specific line, click a COM Port in the Local Port list box, then click the line to which you want to map that particular COM Port. The status message "Mapped to MCSI" should appear above the Local Port list box.

Click **Unmap** if you want to unmap a line.

Click **Search** to search for lines on a server.

Click **Close** when finished.

7. To view a list of mapped COM ports, click **Map | Map List**, or click the **Map** button. Click **Close** when finished.
8. To unmap a COM port, click **Unmap | Unmap**, or click the **Unmap** button. Click the listing you want to unmap and then click **Unmap**.
9. To logout from the network, click **File | Logout**, or click the **Logout** button.
10. To exit from WINMCSI, click **File | Exit**, or click the **Exit** button. Otherwise you may minimize the screen to minimize WINMCSI to an icon.



## Chapter 7 - Remote Configuration and Management





Verify that the **Communication Type** field is set for **COM Port** and the **Select Port** option from the drop-down list matches the COM port of your local PC.

In the **Dial String** field, enter the AT command for dialing (ATDT) plus the phone number of the remote RASFinder.

If your Modem Initialization String, Initialization Response, or Connect Response values are different from the defaults in the dialog box, refer to your modem user documentation and change the values to match those required by your modem.

When you are satisfied with your selections, click **OK**.

6. Run the RASFinder Configuration program. Click **Start | Programs | RASFinder | RASFinder Configuration**, or double-click the RASFinder Configuration icon in the RASFinder program group.
7. The **Dialing Router** dialog box is displayed while software is dialing the remote RASFinder.
8. Once the **Dialing Router** dialog box completes, the **Reading Setup** dialog box is displayed.
9. Once the **Reading Setup** dialog box completes, the **RASFinder - Router Setup** dialog box is displayed. This is the remote RASFinder dialog box. Refer to the on-line Help for a description of each dialog box and field within a dialog box.



10. After you have changed the configuration of the remote RASFinder, click the **Download Setup** button to update the configuration. The remote RASFinder will be brought down, the new configuration written to the unit, and the unit will reboot.
11. After the downloading is complete, click **Exit**.
12. The **Hangup connection with Router?** dialog box is displayed  
Click **Yes** to disconnect the phone connection to the remote site.
13. If the same telephone number is not going to be used again in the immediate future, you may want to remove it from the **Port Setup** dialog box.
14. At the remote site, reconnect the RASFinder to the serial port of the PC and from the Program Manager screen click the **Router Configuration** Icon to verify that the RASFinder is running.

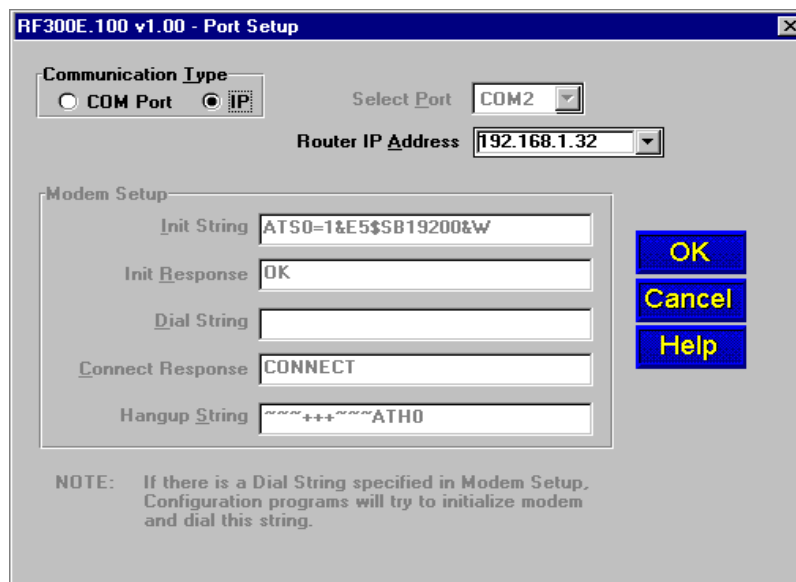
## LAN-Based

The LAN-based remote configuration requires a Windows Sockets compliant TCP/IP stack. TCP/IP protocol software must be installed and functional before the configuration program can be used.

1. You must assign an Internet (IP) address for the PC and for each node that will be managed by the configuration program. Refer to the protocol software documentation for instructions on how to set the IP addresses.

Once you have completed this step, you should be able to use the protocol Ping command for the PC host name. You should also test the network interface configuration by Pinging another TCP/IP device that is connected to the network.

2. Install the RASFinder software on the local PC. When installed, click **Start | Programs | RASFinder | Configuration Port Setup**, or double-click the Configuration Port icon in the RASFinder program group.
3. The **Port Setup** dialog box is displayed.

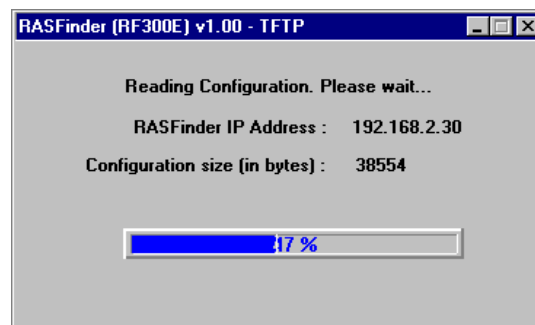


Verify that the **Communication Type** field is set to **IP**.

In the **Router IP Address** field, enter the IP Address of the remote RASFinder.

4. Click **OK** when you are satisfied with your selections.
5. Run the RASFinder Configuration program. Click **Start | Programs | RASFinder | RASFinder Configuration**, or double-click the RASFinder Configuration icon in the RASFinder program group.

The following screen is displayed.



- Once the program has completed reading the configuration, the **RASFinder - Router Setup** dialog box is displayed. This is the main menu for the *remote* RASFinder. Refer to the on-line Help for the definition of each dialog box and field within a dialog box.



- After you have changed the configuration of the remote RASFinder, click **Download Setup** to update the configuration. The remote RASFinder will be brought down, the new configuration written to the unit, and the unit will reboot.
- After downloading is complete, click **Exit**.
- To verify that the RASFinder is running, double-click the **RASFinder Configuration** icon in the **RASFinder** program group.

# Remote Management

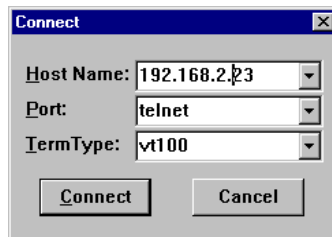
This section describes typical client applications that can be used to configure the RASFinder remotely. It is important to note that although any subsequent changes to configuration can be made using these methods, the initial setup and configuration of the RASFinder must be done from a local PC using the RASFinder software that is provided.

Although establishing access to the RASFinder varies between these applications, the configuration functions correspond to those of the RASFinder software run on a local PC. For more information on RASFinder software, refer to Chapter 4 - RASFinder Software.

## Telnet

A typical Telnet client application is described next. The RASFinder has a built-in Telnet Server that enables Telnet client PCs to access the RASFinder. A typical Telnet client is allowed to configure the RASFinder and its data ports. In addition, the RASFinder can be remotely accessed and configured from anywhere on the connected Internet through its Web interface.

The TCP/IP stack has to be loaded before the Telnet client (a Windows application) will run. The Telnet Server option has to be selected from the **Applications Setup** dialog box using the Router Configuration icon and the Others button on the **RASFinder - Router Setup** dialog box. Double-click the **Telnet** icon (or shortcut) and a blank Telnet screen is displayed. Click **Connect | Remote System** and the **Connect** dialog box is displayed. Select (or enter) a Host Name (the IP address of the RASFinder). In this example, the IP Host Name is 192.168.2.23.

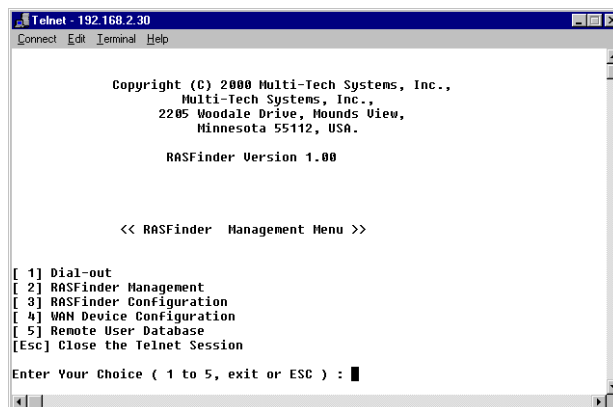


When you enter a valid Host Name (IP address) and click **Connect**, you are immediately connected to the target RASFinder and the RASFinder Management Menu screen is displayed.

## RASFinder Management Menu

The RASFinder Management Menu provides five functional options in addition to the option of escaping and closing the Telnet session.

If you have entered a password in the **Applications Setup** dialog box in the RASFinder software, and have selected an option from the RASFinder Management Menu, you will need to enter your password before your choice is accepted.





To select an option, enter the number of the option and hit the Enter key. For example, to select the Dial-Out option, type **1 <Enter>**. For details on a parameter, refer to the associated on-line Help.

### Dial-Out

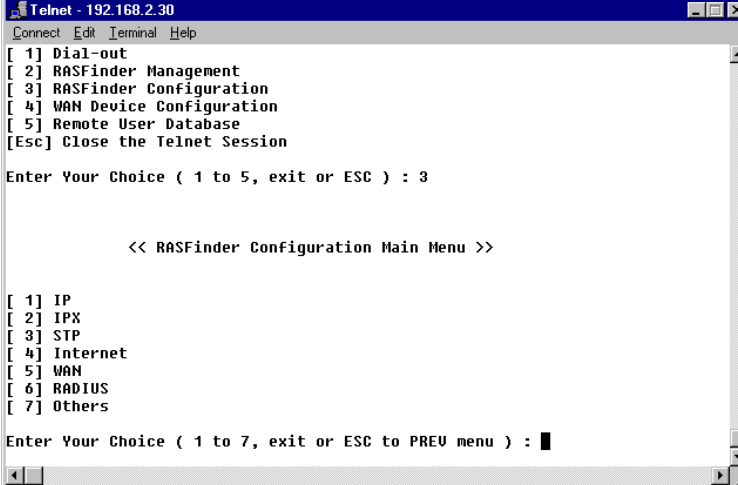
The Dial-out option (Option 1) on the RASFinder Management Menu enables a Telnet user to configure one of the WAN ports for a dial-out session. The default configuration of 115200 bps, 8N1 can be used for the dial-out session, or the user can specify each parameter for the port (e.g., the baud rate, the number of data bits, parity, or the number of stop bits). When the connection is established, anything entered on the keyboard is immediately presented to the selected WAN port. When the dial-out session is over, the WAN port reverts to its original configuration.

### RASFinder Management

The RASFinder Management option (Option 2) on the RASFinder Management Menu enables a Telnet user to view router statistics or system information; another option enables the remote user to Reset the router.

### RASFinder Configuration

The RASFinder Configuration option (Option 3) on the RASFinder Management Menu enables a Telnet user to view and change parameters on the protocol stacks, view or change bridge information, select PPP or SLIP, select a WAN port, or enable/disable the supported servers (applications).



```

Telnet - 192.168.2.30
Connect Edit Terminal Help
[ 1 ] Dial-out
[ 2 ] RASFinder Management
[ 3 ] RASFinder Configuration
[ 4 ] WAN Device Configuration
[ 5 ] Remote User Database
[Esc] Close the Telnet Session

Enter Your Choice ( 1 to 5, exit or ESC ) : 3

      << RASFinder Configuration Main Menu >>

[ 1 ] IP
[ 2 ] IPX
[ 3 ] STP
[ 4 ] Internet
[ 5 ] WAN
[ 6 ] RADIUS
[ 7 ] Others

Enter Your Choice ( 1 to 7, exit or ESC to PREV menu ) : █

```

### WAN Device Configuration

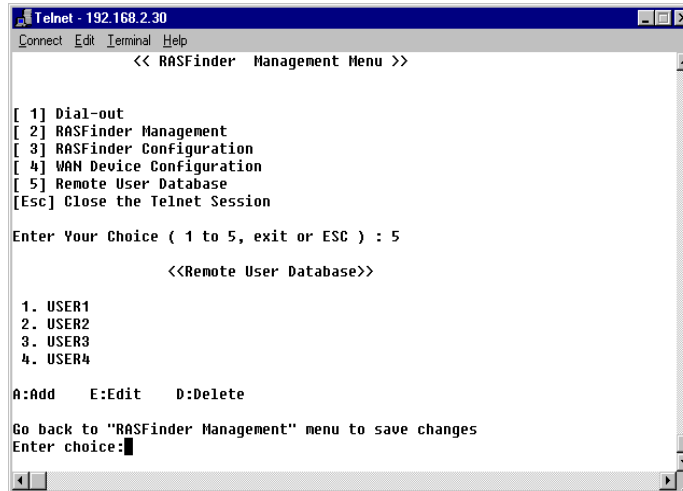
The WAN Device Configuration option (Option 4 on the RASFinder Management Menu) allows a remote user (a Telnet client) to put any port in WANTalk mode.

### Remote User Database

The Remote User Database option (Option 5 on the RASFinder Management Menu) allows a remote user to add user information such as Name and Password, callback information, and which protocol stacks to enable or disable.

## Remote User Database

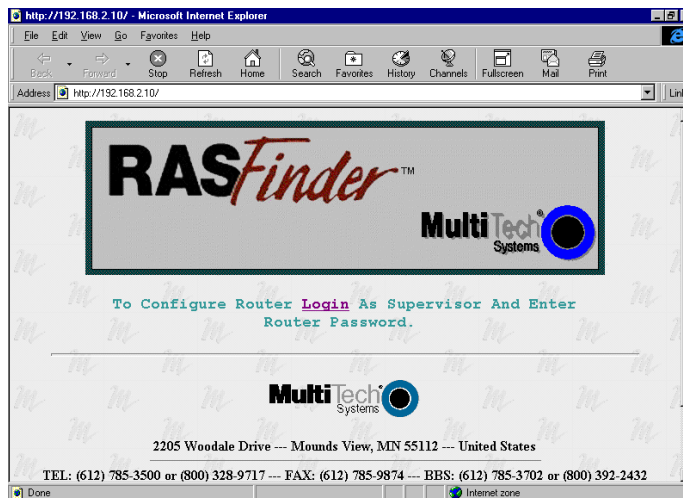
The Remote User Database option from the RASFinder Management Menu enables you to add and configure a list of users who will access the RASFinder remotely. After selecting Remote User Database (type **2** <Enter>) from the main menu, type **A** <Enter> to add a new user to the database. The following list of options is displayed:



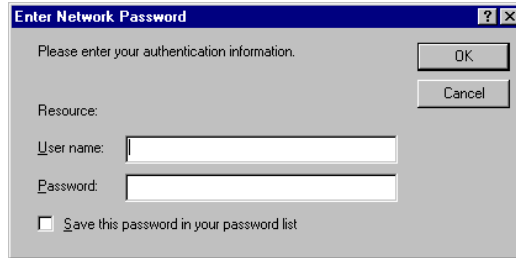
By selecting and configuring the various options and entering the desired information, you can construct a database of remote users for the RASFinder. For a detailed description of each option, refer to the on-line Help provided in your RASFinder software.

## Web Browser Management

The RASFinder can be accessed, via a standard Web browser, from anywhere on the connected Internet. First, WEB Server must be checked (enabled) on the **Applications Setup** dialog box to enable this function. You can then access the **RASFinder Configuration** dialog box by typing the **IP Address** of the unit into the address line of your web browser. The following screen will be displayed:



Click the word **Login** to gain access to the RASFinder. The following screen are displayed:



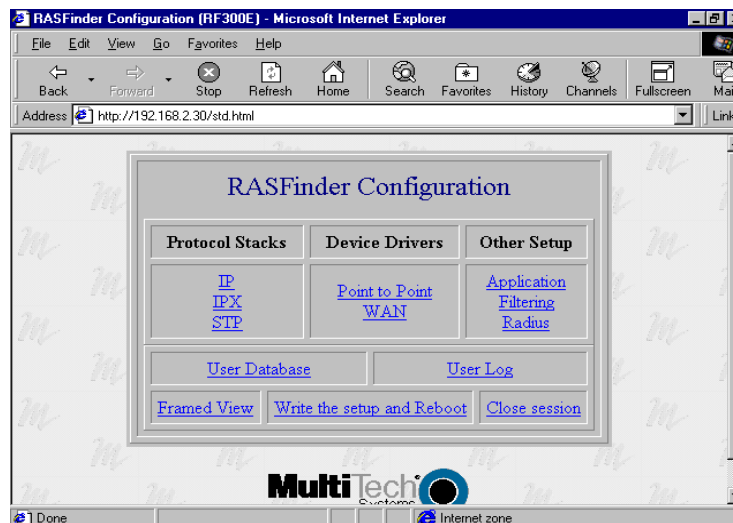
The dialog box titled "Enter Network Password" contains the following elements:

- Text: "Please enter your authentication information." with "OK" and "Cancel" buttons to the right.
- Text: "Resource:"
- Text: "User name:" followed by a text input field.
- Text: "Password:" followed by a password input field.
- Text: "Save this password in your password list" with an unchecked checkbox.

Type **supervisor** in the **User Name** field (no password is needed) and click **OK**. The **RASFinder Configuration** screen is displayed. From the **RASFinder Configuration** screen, you can access current settings and view statistics, as well as configure and download a new setup to the RASFinder.



You can easily switch to the "Standard View" of the RASFinder Configuration menu if you prefer.



**Note:** Only one user can access the RASFinder at any given time, and this user will have *read/write* rights over the unit.





## Chapter 8 - Service, Warranty and Tech Support



## Introduction

This chapter starts out with statements about your RASFinder two-year warranty. The next section, Tech Support, should be read carefully if you have questions or problems with your RASFinder. It includes the technical support phone numbers, space for recording your product information, and an explanation of how to send in your RASFinder should you require service. The final section explains how to obtain a catalog of available documents and then order technical literature using our 24-hour Fax-Back Service.

## Limited Warranty

Multi-Tech Systems, Inc. (“MTS”) warrants that its products will be free from defects in material or workmanship for a period of two years from the date of purchase, or if proof of purchase is not provided, two years from date of shipment. **MTS MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.** This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by the customer or any party without MTS’s written authorization, or used in any manner inconsistent with MTS’s instructions.

MTS’s entire obligation under this warranty shall be limited (at MTS’s option) to repair or replacement of any products which prove to be defective within the warranty period, or, at MTS’s option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS’s factory transportation prepaid.

**MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PURCHASE PRICE FOR DEFECTIVE PRODUCTS.**

## On-line Warranty Registration

If you would like to register your RASFinder electronically, you can do so at the following address:

<http://www.multitech.com/register/>

## Tech Support

Multi-Tech has an excellent staff of technical support personnel available to help you get the most out of your Multi-Tech product. If you have any questions about the operation of this unit, call 1-800-972-2439. Please fill out the RASFinder information (below), and have it available when you call. If your RASFinder requires service, the tech support specialist will guide you on how to send in your RASFinder (refer to the next section).

## Recording RASFinder Information

Please fill in the following information on your Multi-Tech RASFinder. This will help tech support in answering your questions. (The same information is requested on the Warranty Registration Card.)

Model No.: \_\_\_\_\_  
Serial No.: \_\_\_\_\_  
Software Version: \_\_\_\_\_

The model and serial numbers are on the bottom of your RASFinder.

Please note the type of external link device that is connected to your RASFinder before calling tech support. Also, note the status of your RASFinder including LED indicators, screen messages,

diagnostic test results, problems with a specific application, etc. Use the space below to note the RASFinder status:

---

---

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### Contacting Tech Support via E-mail

If you prefer to receive technical support via the Internet, you can contact Tech Support via e-mail at the following address:

<http://www.multitech.com/>

### Service

If your tech support specialist decides that service is required, your RASFinder may be sent (freight prepaid) to our factory. Return shipping charges will be paid by Multi-Tech Systems.

Include the following with your RASFinder:

- a description of the problem.
- return billing and return shipping addresses.
- contact name and phone number.
- check or purchase order number for payment if the RASFinder is out of warranty. (Check with your technical support specialist for the standard repair charge for your RASFinder).
- if possible, note the name of the technical support specialist with whom you spoke.

If you need to inquire about the status of the returned product, be prepared to provide the **serial number** of the product sent.

Send your RASFinder to this address:

MULTI-TECH SYSTEMS, INC.  
2205 WOODALE DRIVE  
MOUNDS VIEW, MINNESOTA 55112  
ATTN: SERVICE OR REPAIRS

You should also check with the supplier of your RASFinder on the availability of loaner units and/or local service in your area.

### About the Internet

Multi-Tech's presence includes a Web site at:

<http://www.multitech.com>

and an ftp site at:

<ftp://ftp.multitech.com>

## Ordering Accessories

SupplyNet, Inc. supplies replacement transformers, cables and connectors for select Multi-Tech products. You can place an order with SupplyNet via mail, phone, fax or the Internet at:

**Mail:** SupplyNet, Inc.  
614 Corporate Way  
Valley Cottage, NY 10989


**Phone:** 800 826-0279

**Fax:** 914 267-2420

**Email:** [info@thesupplynet.com](mailto:info@thesupplynet.com)

**Internet:** <http://www.thesupplynet.com>

### SupplyNet On-line Ordering Instructions

1. Browse to <http://www.thesupplynet.com>. In the **Browse by Manufacturer** drop-down list, select **Multi-Tech** and click 
2. To order, type in quantity, and click 
3. Click  to change your order
4. After you have selected all of your items click  to finalize the order. The SupplyNet site uses Verisign's Secure Socket Layer (SSL) technology to ensure your complete shopping security.



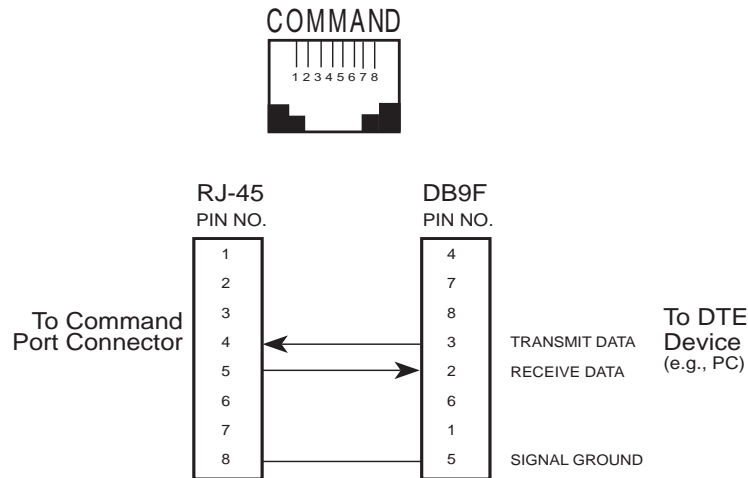


## Appendixes

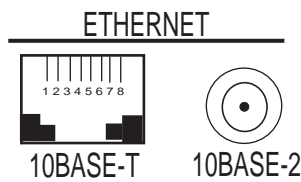


# Appendix A - Cabling Diagrams

## Command Port Cable



## LAN Cables



Pin	Circuit Signal Name	Pin	Description
1	TD+ Data Transmit Positive	1	Center
2	TD- Data Transmit Negative	2	Shield
3	RD+ Data Receive Positive		
6	RD- Data Receive Negative		

## WAN Cables



Pinout Chart			
Extra, unused pins are acceptable			
RJ45	Signal Type	S/T-Interface	U-Interface
DCE		DTE	DTE
3	Transmit data (+)	3	
4	Receive data (+)	4	4
5	Receive data (-)	5	5
6	Transmit data (-)	6	

## Appendix B - Script Language

The script file can be used to automate certain operations. The script file is a text file containing a sequence of commands. The structure of a script file is succinctly expressed by the following grammar.

### Script Language Grammar

```

<program>           =<declarations> <proc_declarations>
<declarations>     ={<var_type> <identifier> {, <identifier> } ; }
<var_type>         =INTEGER | STRING
<statement_list>   ={<statement>}
<statement>        =<elementary_statement> | <if_statement> | <for_statement> |
                    <while_statement> | <switch_statement>
<if_statement>     =IF <expression> THEN <statement_list> {ELSE<statement_list> } ENDIF
<for_statement>    =FOR <identifier>=<expression> TO IDOWNTO <expression> STEP
                    <expression> / DO <statement_list> ENDFOR
<while_statement> =WHILE <expression> DO <statement_list> ENDWHILE
<switch_statement> =SWITCH <expression> {CASE <integer_const> <statement_list> |
                    CASE <string_const> <statement_list> |
                    DEFAULT <statement_list> }
                    ENDSWITCH
<elementary_statement> =<identifier> = <expression> ; | <identifier> / (<expression>
                    {,<expression> } ) / ; | GOTO <identifier> ; | <identifier> : | ;
<expression>       =<expression> OPERATOR <expression> | {<expression> } | /<expression>|
                    - <expression> | <identifier> / (<expression> {, <expression> } ) /
OPERATOR           = < | <= | > | >= | == | != | && | || | + | - | * | / | !
<proc_declaration> =PROC <identifier>/(<parameter_list>){ :<vartype> };FORWARD ;
<proc_declaration> =PROC <identifier>/(<parameter_list>)/ : <vartype> / ;
                    <declarations> <statement_list>ENDPROC
<parameter_list>  =<argument_list> { ; <argument_list>}
<argument_list>   ={VAR} <var_type> <identifier> {<identifier>}

```

Execution starts at the PROC main. PROC main cannot have any arguments. All the variables have to be declared before use. All procedures must be declared before calling. Recursion is allowed in procedures.

To define mutually recursive procedures, use the FORWARD directive to indicate that the procedure body is defined later in the source file. Procedures defined with the FORWARD directive should have all the parameters and return value (if any) specified, the actual definition of the procedure body should not contain the formal parameter list or the return value. An example of forward defined procedures is given below:

```

proc a(integer x,y) : integer,forward:
proc b(integer u,v) : integer,forward:
proc a;
    integer t;
    /*Some more code here. */

    t=b(x,y);
    /*Some more code here. */
    return(t);
endproc

proc b;
    return(a(u,v);
endproc

```

Argument to procedures can be passed by value or address. To pass an argument by address, prefix the argument name in the formal parameter list by the keyword VAR; otherwise the argument is passed by value. Only variables can be passed by address. Expressions like A+B, where A and B are integer variables can be passed by value but cannot be passed by address.

**Two basic types of variables are supported:**

INTEGER and STRING

In the STRING, since the ASCII null character is internally used to indicate the end of the sequence, it cannot be part of the string. All other characters, including extended ASCII characters can be part of the string.

**There are two types of conditional constructs:**

IF and SWITCH

The IF statement is a two-way branching construct. The condition can be an arbitrary expression. The condition in the IF statement should evaluate to an integer or real. If the expression in the IF statement evaluates to non-zero, the control enters the THEN statement, otherwise control enters the ELSE statement.

The SWITCH statement is a multi-way branching construct. The type of conditional expression should be either INTEGER or STRING. The value of the conditional expression is matched against the constraints given in the CASE options, if the value matches a CASE option value, control enters that CASE option. If the values do not match any of the CASE options, and if a DEFAULT option is provided, control continues at the DEFAULT option; otherwise control continues at the statement after the ENDSWITCH. If control enters one of the CASE or DEFAULT statements, all the statements up to the next ENDCASE statement are executed. Each CASE or DEFAULT statement should be terminated by a matching ENDCASE keyword. The SWITCH statement should be terminated by a ENDSWITCH keyword. The DEFAULT statement can be placed anywhere within the scope of the SWITCH statement. There can be only one DEFAULT statement.

**There are two types of iterative constructs:**

FOR and WHILE

The FOR construct sets the loop control variable to an initial value. The control variable is checked for bounds, and if within bounds, the <statement\_list> given is executed; otherwise the loop execution terminates. After each execution of <statement\_list>, the control variable is incremented or decremented by a certain value. This is computed as follows: if the STEP expression is given it is the value of the expression, else it is 1. The control variable is incremented if TO is specified, and is decremented if DOWNTO is specified. After updating the control variable the bounds check is done again. The keyword ENDFOR is mandatory at the end of the loop.

The WHILE loop has an expression and a <statement\_list>. The expression is evaluated and if the expression is non-zero the <statement\_list> is executed; otherwise the loop execution terminates. The keyword ENDWHILE is mandatory at the end of the loop.

**Operator Precedence:**

Operators are listed in the order of precedence

Unary Operators :-(unary minus, logical negation)

Binary Operators :\*/ + \_< > <= >= == != && ||

All the operators are left associative. Expressions are evaluated completely; so care must be taken while writing expressions. For example, expressions like (a !=0 && b / a) would create run time error.

**Example Script:**

```
proc main;
    string login_prompt;
    string user_name;
    string password_prompt;
    string password;
    string shell_menu;
    string shell_menu_response;
    integer timeout;

    timeout=10;
    login_prompt="login:";
    user_name="user1";
    password_prompt="Password:";
    password="user1";
    shell_menu="choice:";
    shell_menu_response="1";

    transmit("A");
    wait(1)
    transmit("T^M");
    waitfor ("OK",10);

    transmit ("A");
    wait (1);
    transmit ("T");
    wait (1);
    transmit ("DT963^M");

    if (waitfor (login_prompt,60)) then
        transmit (user_name);
        transmit ("^M");
        if (waitfor (password_prompt,timeout)) then
            transmit (password);
            transmit ("^M");
            if (waitfor (shell_menu,timeout)) then
                transmit (shell_menu_response);
                transmit ("^M");
            else
                transmit ("Shell Menu Not Received^M");
            endif
        else
            transmit ("Password Prompt Not Received^M");
        endif
    else
        transmit ("Login Prompt Not Received^M");
    endif

Endproc
```

## Appendix C - Regulatory Information

### Class B Statement

#### FCC Part 15

**NOTE:** This equipment has been tested and found to comply with the limits for a **Class B** digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference that may cause undesired operation.

**Warning:** Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

#### Industry Canada

**This Class B** digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

### Fax Branding Statement

The Telephone Consumer Protection Act of 1991 makes it unlawful for any person to use a computer or other electronic device, including fax machines, to send any message unless such message clearly contains the following information:

- Date and time the message is sent
- Identification of the business or other entity, or other individual sending the message
- Phone number of the sending machine or such business, other entity, or individual

This information is to appear in a margin at the top or bottom of each transmitted page or on the first page of the transmission. (Adding this information in the margin is referred to as *fax branding*.) Since any number of Fax software packages can be used with this product, the user must refer to the Fax software manual for setup details. Typically, the Fax branding information must be entered via the configuration menu of the software.

## FCC Part 68 Telecom

1. This equipment complies with Part 68 of the Federal Communications Commission (FCC) rules. On the outside surface of this equipment is a label that contains, among other information, the FCC registration number. This information must be provided to the telephone company.
2. As indicated below, the suitable jack (Universal Service Order Code connecting arrangement) for this equipment is shown. If applicable, the facility interface codes (FIC) and service order codes (SOC) are shown.
3. An FCC-compliant telephone cord with modular plug is provided with this equipment. This equipment is designed to be connected to the phone network or premises wiring using a compatible modular jack which is Part 68 compliant. See installation instructions for details.
4. The ringer equivalence number (REN) is used to determine the number of devices that may be connected to the phone line. Excessive REN's on the phone line may result in the device not ringing in response to an incoming call. In most, but not all areas, the sum of the REN's should not exceed (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total REN's, contact the local phone company.
5. If this equipment causes harm to the phone network, the phone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the phone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.
6. The phone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the phone company will provide advance notice in order for you to make necessary modifications in order to maintain uninterrupted service.
7. If trouble is experienced with this equipment (the model of which is indicated below) please contact Multi-Tech Systems, Inc., at the address shown below for details of how to have repairs made. If the equipment is causing harm to the network, the phone company may request that you remove the equipment from the network until the problem is resolved.
8. No repairs are to be made by you. Repairs are to be made only by Multi-Tech Systems or its licensees. Unauthorized repairs void registration and warranty.
9. This equipment should not be used on party lines or coin lines.

Manufacturer:	Multi-Tech Systems, Inc.
Trade name:	RASFinder
Model Numbers:	RF300E
FCC Registration Number:	AU7USA-24994-M5-E
Ringer Equivalence:	0.6B
Modular Jack:	RJ-11C or RJ-11W
Service Center in U.S.A.:	Multi-Tech Systems Inc. 2205 Woodale Drive Mounds View, MN 55112 (612) 785-3500 Fax (612) 785-9874

## Canadian Limitations Notice

### Ringer Equivalence Number

**Notice:** The ringer equivalence number (REN) assigned to each terminal device provides an indication of the maximum number of terminals allowed to be connected to a phone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

**Notice:** The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations. Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, phone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

**Caution:** Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.



### EMC, Safety and Terminal Directive Compliance

The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility.

and

Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits:

and

Council Directive 98/13/EC of 12 March 1998 on the approximation of the laws of Member States concerning telecommunications terminal and Satellite earth station equipment.



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## Appendix D - AT Commands

One of the means by which you can communicate with and configure your RASFinder is to use AT commands. AT commands are so-called because, with only a few exceptions, each command string must begin with the characters *AT*. Using AT commands, you can read and set parameters, and perform actions such as dialing.

### Entering AT Commands

If your RASFinder is connected to a computer terminal, you can send AT commands to the RASFinder by typing them on the terminal keyboard. If your RASFinder is connected to a computer, you can send AT commands to the RASFinder by typing them in the terminal window of a data communications program such as HyperTerminal. You can also send some AT commands indirectly by configuring your data communications program.

Enter AT commands in the format ***AT <command string> <CR>***. The characters *AT* cause the RASFinder to interpret the following string as a command. The command string consists of one or more commands. The carriage return character, *<CR>*, sends the command string to the RASFinder. If you are entering a command string in your communication program's terminal window, insert the carriage return character by pressing the ENTER key on your keyboard. If you are configuring a communications program, on the other hand, you typically must insert the carriage return character by adding "*^M*" to the end of the command string.

The RASFinder has three modes of operation: offline command mode (the default state), online command mode, and data mode. The RASFinder responds to AT commands only when it is in one of the command modes. After the RASFinder establishes a connection and goes online in data mode, it interprets any further characters you enter as data, rather than as commands, and transmits them to the remote device.

When the RASFinder is in data mode, you can switch it to online command mode by sending it an *escape sequence*. The RASFinder responds to two types of escape sequences: in-band, in which the escape sequence is part of the data stream, and out-of-band, in which the escape sequence is outside the data stream. The in-band escape sequence is ***+++AT<CR>***; the out-of-band escape sequence is ***<Break >AT<CR>***. You can change the in-band escape character (+) by changing the value in register ***S2***. You can send the break signal in the out-of-band escape sequence only from software, *not* by pressing SHIFT+BREAK on your keyboard.

When it detects the escape sequence, the RASFinder enters online command mode, in which it responds to commands while maintaining the connection with the remote device.

The RASFinder's command buffer can store 80 characters, including spaces and other characters used in telephone numbers. If you mis-type a command string, you can edit it by using the backspace or the delete key, but only before you press ENTER. As you type a command string, it appears on your monitor screen, letting you verify your input as you type it.

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## D.1 AT Commands

The TA's command buffer can store 80 characters, including spaces and other characters used in telephone numbers. If you mistype a command string, you can edit it by using the backspace or the delete key, but only before you press **<CR>**. As you type a command string, it appears on your monitor screen, letting you verify your input as you type it. D-1 lists the AT commands recognized by the TA.

**Table-1. AT Commands by Function (D.1.1)**

AT	Attention code
Return	Command execution
+++AT<CR>	In-band escape code
<BREAK>AT<CR>	Out-of-band escape code

### General Information Commands (D.1.2)

In	Display Product Information
Ln	List Active Profile Information
!L	Display Network Configuration
>MIBn	Management Information Block (MIB) Information

### Network Configuration Commands (D.1.3)

%A97=n	Dialing Method
>A0=n	Type of Coding
!C0=n	Network Switch Type
!C6=n	Data SPID
*!C6=n	Voice SPID

---

!D0=n	V.120 LLC Information Element
!D3=n	SAPI-0 Data TEI
*!D3=n	SAPI-0 Voice TEI
!DNn	Disable Data DN/MSN n
*!DNn	Disable Voice DN/MSN n
!ENn	Enable Data DN/MSN n
*!ENn	Enable Voice DN/MSN n
!Nn=s	Data DN/MSN n
*!Nn=s	Voice DN/MSN n

#### Serial Port Configuration Commands (D.1.4)

&Cn	DCD (Data Carrier Detect) Control
&Dn	DTR (Data Terminal Ready) Control
\$Dn	Persistent DTR Dialing
&En	Flow Control
&Rn	CTS (Clear To Send) Control
&RFn	CTS/RTS Interaction Control
&Sn	DSR (Data Set Ready) Control
!SW	Switch Serial Port Control to TA
*!SW	Switch Serial Port Control to Modem
#Xn	Send Multiple Xoff Characters

#### General Configuration Commands (D.1.5)

@CONFIG	Configuration Menu
En	Command Mode Echo
%En	Escape Sequence Options
&Fn	Load Factory Profile
%Mn	Management Mode
Qn	Quiet Mode
Sr=n	Set S-register
Sr?	Read S-register
Vn	Terse/Verbose Result Codes
&Wn	Store Active Profile
Xn	Connect Messages
Zn	Reset to Stored Profile
&Zn=	Store Telephone Number
!Z=n	Rate Adaption/Data Protocol

#### Digital (Data) Call Commands (D.1.6)

A	Answer Digital Call
Dn	Dial Digital Number
DSn	Dial Stored Number
Hn	Hang up Digital Call
!Hn	Digital Call Hold-off Time
On	Return Online

#### Analog (POTS) Call Commands (D.1.7)

*An	Answer Analog Call
*Bn	Send Analog Dial Digit
*Dn	Dial Analog Number
*Hn	Hang up Analog Call
*!Hn	Analog Call Hold-off Time

### D.1.1 Command Execution

Command: **AT**  
 Function: Attention Code  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: This attention code precedes all command strings except the **A/** command and escape codes.

Command: **RETURN** or **ENTER**  
 Function: Command Execution  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: Press the RETURN (ENTER) key to execute a command. The RETURN key is frequently abbreviated **<CR>** in command examples.

Command: **+++AT<CR>**  
 Function: In-Band Escape Code  
 Unit: ASCII  
 Values: Set by S-register **S2**  
 Default: **+ (S2=43)**  
 Description: The **+++AT<CR>** command causes the TA to enter command mode, without disconnecting the call, when it is online with a remote device. The default escape code is three + characters, followed by the letters AT, up to 80 command characters, and a RETURN (press ENTER). The TA escapes to command mode, executes any commands in the string, and then remains in command mode. Use the **S2=n** command to change the escape character.

Command: **<BREAK>AT<CR>**  
 Function: Out-of-Band Escape Code  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: This command places the TA in command mode while remaining online. Enter a break signal, the letters AT, up to 80 command characters, and a RETURN (press ENTER).

### D.1.2 General Information Commands

Command: **In**  
 Function: Display Product Information  
 Unit: Decimal ASCII code  
 Values: n=0—Product ID (e.g. 247)  
           n=1—Firmware version number (e.g. 1.02)  
           n=2—Product model  
           n=3—Product features  
           n=4—Date and time firmware was generated  
           n=8—Current settings used by Windows for descriptor identification  
           n=9—Product name  
           n=11—Digital Port Connection Information  
           n=12—Analog Port Connection Information  
           n=20—Extended Product name  
           n=99—Crystal frequency

Default:	<b><i>IO</i></b>
Description:	The <b><i>In</i></b> command displays specific product information depending on the value of <i>n</i> .
Command:	<b><i>Ln</i></b>
Function:	List Active Profile Information
Unit:	Decimal ASCII code
Values:	<b><i>n=0</i></b> —List stored numbers <b><i>n=5</i></b> —List AT command settings <b><i>n=6</i></b> —List S-register summary <b><i>n=8</i></b> —List Low-level ISDN Statistics <b><i>n=9</i></b> —List Connection Statistics
Default:	<b><i>LO</i></b>
Description:	The <b><i>Ln</i></b> command lists information for various settings or lists various statistics depending on the value of <i>n</i> .
Command:	<b><i>!L</i></b>
Function:	Display Network Configuration
Unit:	n/a
Values:	n/a
Default:	n/a
Description:	Use the <b><i>!L</i></b> command to display the TA's current network configuration: MSN/DN, SPID, TEI, Data protocol, switch type, etc.
Command:	<b><i>&gt;MIBn</i></b>
Function:	Management Information Block (MIB) Information
Unit:	Decimal ASCII code
Values:	<b><i>n=0</i></b> through <b><i>n=(number of digital plus analog ports)-1</i></b>
Default:	<b><i>&gt;MIB0</i></b>
Description:	<b><i>&gt;MIBn</i></b> displays the Management Information Block (MIB) information for the port specified by <i>n</i> . If <i>n</i> is not specified, <i>n</i> is assumed to be 0. <i>n=0</i> is the first digital port. Digital port information is identical to the <b><i>!11</i></b> information. Analog ports follow the digital ports and analog port information is identical to the <b><i>!12</i></b> information. If there are two digital ports ( <i>n=0</i> and <i>n=1</i> ), then the first analog port (if any) will be port <i>n=2</i> , the second analog port (if it exists) is port <i>n=3</i> , etc. <b><i>&gt;MIBn</i></b> simply allows a specific port to display the <b><i>!11</i></b> or <b><i>!12</i></b> information of a port other than the one currently receiving the <b><i>&gt;MIBn</i></b> command.

### D.1.3 Network Configuration Commands

Use the following commands to select your network switch type (e.g., EuroISDN NET3, VN4, INS64, etc.), specify data directory/multiple subscriber numbers, specify TEI values if required, and to specify other information required to make an ISDN connection.

Command:	<b><i>%A97=n</i></b>
Function:	Dialing Method
Unit:	Decimal ASCII code
Values:	<b><i>n=0</i></b> (En bloc sending during call SETUP) <b><i>n=1</i></b> (Overlap sending during call SETUP)
Default:	<b><i>%A97=0</i></b> (En bloc)
Description:	Standardized ISDN signaling protocols, such as DSS1, DSS2, and SS7, support a <i>sending complete indication</i> ; i.e., a signal that no more digits will follow. However, appending such a signal to a telephone number is often impractical; therefore, many private networks send the number of a called party by using a procedure called <i>overlap sending</i> , in which no sending complete indication is sent. Computer users, however, can automatically append the sending complete indication to the telephone number by choosing the <i>en bloc</i> method of sending, which results in faster call setup.

Use the **%A97=n** command to select between the two methods.

Command: **>A0=n**  
 Function: Type of Coding (Speech/3.1KHz Audio)  
 Unit: Decimal ASCII code  
 Values: n=0 (A-law), n=1 (u-law)  
 Default: Switch-type dependent:  
 AT&T 5ESS — n=1 (u-law)  
 DMS-100 — n=1 (u-law)  
 EuroISDN NET3 — n=0 (A-law)  
 INS64 — n=1 (u-law)  
 US NI-1 — n=1 (u-law)  
 VN4 — n=0 (A-law)

Description: With **>A0=n** it is possible to use a type of Speech/3.1KHz Audio coding that differs from the default type of coding for a specific switch type. This capability is useful for countries that require a specific switch type and a specific type of coding. For example, now it is possible to use u-law coding with NET3, which is how it is used in Tiwan, whereas NET3 by default uses A-law coding. **ATIL<CR>** or the **@CONFIG** configuration menu may be used to review the type of coding.

Command: **!C0=n**  
 Function: Network Switch Type  
 Unit: Decimal ASCII code  
 Values: n=0 (AT&T 5ESS)  
 n=1 (Northern Telecom DMS-100)  
 n=2 (EuroISDN NET3)  
 n=4 (INS64)  
 n=5 (US NI-1)  
 n=6 (VN4)  
 Default: **!C0=2** (NET3)

Description: Use the **!C0=n** command to select one of the network switch types supported by the TA. The factory default setting is **!C0=2** (NET3). Refer to the **>A0=n** command for a list of the default type of coding for the respective switch type. **AT!C0?<CR>** or **ATIL<CR>** may be used to review the switch type. The **@CONFIG** configuration menu can also be used to set and review the switch type.

Command: **!C6=n**  
 Function: Data SPID  
 Unit: ASCII  
 Values: n=0- to 20-character string  
 Default: null string

Description: Use the **!C6=n** command to specify the data service profile identifier (SPID) that the ISDN service provider assigned at subscription time. The data SPID string can have up to 20 characters. *This command is not used if the switch type is set to NET3, VN4, INS6D.* **AT!C6?<CR>** may be used to review the Data SPID or **ATIL<CR>** may be used to review all SPID numbers. The **@CONFIG** configuration menu can also be used to set and review the Data SPID.

**NOTE:** For DMS-100 switches, any ASCII character except the underline () character is valid. For US NI-1 and AT&T switches, only the digits 0-9 are valid.

Command: **\*!C6=n**  
 Function: Voice SPID  
 Unit: ASCII  
 Values: n=0- to 20-character string  
 Default: null string

Description: Use the **\*!C6=n** command to specify the voice service profile identifier (SPID) that the ISDN service provider assigned at subscription time. The voice SPID string can have up to 20 characters. *This command is not used if the switch type is set to*

*NET3, VN4, INS6D. AT\*IC6?<CR>* may be used to review the Voice SPID or *AT/IL<CR>* may be used to review all SPID numbers. The **@CONFIG** configuration menu can also be used to set and review the Voice SPID.

**NOTE:** For DMS-100 switches, any ASCII character except the underline () character is valid. For US NI-1 and AT&T switches, only the digits 0-9 are valid.

- Command: ***ID0=n***  
 Function: V.120 LLC Information Element  
 Unit: Decimal ASCII code  
 Values: n=**0** (disable),  
 n=**1** (enable)  
 Default: ***ID0=0*** (disabled)  
 Description: Some switches do not support ISDN SETUP messages that contain a LLC (Low Layer Compatibility) Information Element (IE). When these switches receive a LLC IE in the SETUP they immediately reject the call and then the TA reports NO CARRIER. The LLC IE for V.120 may be disabled by using ***ID0=0*** to avoid problems with switches that do not support a LLC IE. The V.120 LLC IE only helps the answering TA determine the type of digital call and various options associated with that call and so it is not necessary.
- Command: ***ID3=n***  
 Function: SAPI-0 Data TEI  
 Unit: Decimal ASCII code  
 Values: n=**0-63** (Sets the TEI to a fixed value from 0 through 63)  
 n=**240** (Sets the data channel for dynamic TEI negotiation)  
 n=**241** (Disables TEI)  
 Default: ***ID3=240*** (Auto TEI)  
 Description: Use the ***ID3=n*** command to set the terminal endpoint identifier (TEI) for the data channel. A TEI is a number used by the central office switch to uniquely identify each device that is connected to the network. When it uses dynamic TEI assignments (auto TEI), the central office switch assigns a TEI each time the TA connects to the network. However, the ISDN service provider may assign a fixed TEI at subscription time, in which case you must configure the TA with the fixed TEI number. You can also use the ***ID3=n*** command to disable the data channel, which may be useful when multiple TAs are attached to a network terminator bus. ***AT!ID3?<CR>*** may be used to review the Data TEI or ***AT/IL<CR>*** may be used to review all TEI numbers. The **@CONFIG** configuration menu can also be used to set and review the Data TEI.
- Command: ***\*!D3=n***  
 Function: SAPI-0 Voice TEI  
 Unit: Decimal ASCII code  
 Values: n=**0-63** (Sets the TEI to a fixed value from 0 through 63)  
 n=**240** (Sets the voice channel for dynamic TEI negotiation)  
 n=**241** (Disables TEI)  
 Default: ***\*!D3=240*** (Auto TEI)  
 Description: Use the ***\*!D3=n*** command to set the TA's terminal endpoint identifier (TEI) for the voice channel. A TEI is a number used by the central office switch to uniquely identify each device that is connected to the network. When it uses dynamic TEI assignments (auto TEI), the central office switch assigns a TEI each time the TA connects to the network. However, the ISDN service provider may assign a fixed TEI at subscription time, in which case you must configure the TA with the fixed TEI number. You can also use the ***\*!D3=n*** command to disable the voice channel, which may be useful when multiple TAs are attached to a network terminator bus. ***AT\*!D3?<CR>*** may be used to review the Voice TEI or ***AT/IL<CR>*** may be used to review all TEI numbers. The **@CONFIG** configuration menu can also be used to set and review the Voice TEI.

Command: ***IDNn***  
 Function: Disable Data DN/MSN n  
 Unit: Decimal ASCII code  
 Values: n=1 (disable Data DN/MSN 1),  
 n=2 (disable Data DN/MSN 2)  
 Default: All ports are enabled  
 Description: ***IDNn*** disables a Data DN/MSN which will effectively disable the associated TA port from receiving any data calls. However, the port will still be able to originate data calls. This is useful for applications where a specific port is for dial-out only. Since the TA has only one serial port, both Data DN/MSN 1 and 2 would have to be disabled in order to not accept a call. If no port number is given then the assumed port number is that of the port from which the command was received. If port *n* had a DN/MSN set, then that DN/MSN is not erased. Enabling the port later by using the **@CONFIG** configuration menu or the ***!ENn*** command will re-enable that DN/MSN. ***ATIL<CR>*** may be used to review which ports are disabled (displays PORT DISABLED). The **@CONFIG** configuration menu can also be used to disable or review the disabled ports.

Command: ***\*!DNn***  
 Function: Disable Voice DN/MSN n  
 Unit: Decimal ASCII code  
 Values: n=1 (disable Voice DN/MSN 1)  
 n=2 (disable voice DN/MSN 2)  
 Default: All ports are enabled  
 Description: ***\*!DNn*** disables a Voice DN/MSN which will effectively disable the associated voice port from receiving any voice calls. However, the port will still be able to originate voice calls. This is useful for applications where a specific port is for dial-out only or one doesn't want to accept voice calls at that time. If no port number is given then the assumed port number is that of the port from which the command was received. If port *n* had a DN/MSN set, then that DN/MSN is not erased. Enabling the port later by using the **@CONFIG** configuration menu or the ***\*!ENn*** command will re-enable that DN/MSN. ***ATIL<CR>*** may be used to review which ports are disabled (displays PORT DISABLED). The **@CONFIG** configuration menu can also be used to disable or review the disabled ports.

Command: ***!ENn***  
 Function: Enable Data DN/MSN n  
 Unit: Decimal ASCII code  
 Values: n=1 (enable Data DN/MSN 1),  
 n=2 (enable Data DN/MSN 2)  
 Default: All ports are enabled  
 Description: ***!ENn*** enables a Data DN/MSN which will put it back in service for accepting and originating data calls. If no port number is given then the assumed port number is that of the port from which the command was received. ***ATIL<CR>*** may be used to review which ports are enabled (any port that does not display PORT DISABLED). The **@CONFIG** configuration menu can also be used to enable or review the disabled ports.

Command: ***\*!ENn***  
 Function: Enable Voice DN/MSN n  
 Unit: Decimal ASCII code  
 Values: n=1 (enable voice DN/MSN 1)  
 n=2 (enable modem DN/MSN 2)  
 Default: All ports are enabled  
 Description: ***\*!ENn*** enables a Voice DN/MSN which will put it back in service for accepting and originating voice calls. If no port number is given then the assumed port number is that of the port from which the command was received. ***ATIL<CR>*** may be used to review which ports are enabled (any port that does not display PORT DISABLED).



The **@CONFIG** configuration menu can also be used to enable or review the disabled ports.

Command: **!N=s**  
 Function: Data DN/MSN *n*  
 Unit: Decimal ASCII code  
 Values: *n*=1 (Data DN/MSN 1)  
           *n*=2 (Data DN/MSN 2)  
           *s*=25-character string  
 Default: null string  
 Description: The **!N=s** command sets the Directory Number (DN)/Multiple Subscriber Number (MSN) for data port *n* to the character string given by *s*. The DN/MSN is a telephone number (address) that is assigned to the TA at subscription time by the ISDN service provider. The DN/MSN is a string of up to 25 characters; valid characters are 0-9, the \* character, and the # character. A ":" (colon) is used to separate the address from the subaddress if a subaddress is required. All data port DN/MSN numbers can be left empty, be the same, be different, or any combination of those choices. The TA uses the Data DN/MSN to discriminate which data calls may be answered. It also supplies the Calling Party Information Element with a calling party number and calling party subaddress if **S56** is enabled. If no port number *n* is given, then the assumed port number is that of the port from which the command was received. **AT!Nn?<CR>** may be used to review the Data DN/MSN for port *n* or **AT!L<CR>** may be used to review all Data DN/MSN port settings. The **@CONFIG** configuration menu can also be used to set and review the Data DN/MSN port settings.

Command: **\*!N=s**  
 Function: Voice DN/MSN *n*  
 Unit: Decimal ASCII code  
 Values: *n*=1 (Voice DN/MSN 1)  
           *n*=2 (Voice DN/MSN 2)  
           *s*=25-character string  
 Default: null string  
 Description: The **\*!N=s** command sets the Directory Number (DN)/Multiple Subscriber Number (MSN) for voice port *n* to the character string given by *s*. The DN/MSN is a telephone number (address) that is assigned to the TA at subscription time by the ISDN service provider. The DN/MSN is a string of up to 25 characters; valid characters are 0-9, the \* character, and the # character. A ":" (colon) is used to separate the address from the subaddress if a subaddress is required. All voice port DN/MSN numbers can be left empty, be the same, be different, or any combination of those choices. The TA uses the Voice DN/MSN to discriminate which analog calls may be answered. It also supplies the Calling Party Information Element with a calling party number and calling party subaddress if **S56** is enabled. If no port number *n* is given, then the assumed port number is that of the port from which the command was received. **AT\*!Nn?<CR>** may be used to review the Voice DN/MSN for port *n* or **AT\*!L<CR>** may be used to review all Voice DN/MSN port settings. The **@CONFIG** configuration menu can also be used to set and review the Voice DN/MSN port settings.

#### D.1.4 Serial Port Configuration Commands

Use the following commands to control the interaction between the TA and the computer/terminal that is connected to it.

Command: **&Cn**  
 Function: DCD Control  
 Unit: Decimal ASCII code  
 Values: n=0—DCD is forced high at all times.  
 n=1—DCD goes from low to high when the TA establishes a connection (DCD normal).  
 n=2—DCD drops briefly following a disconnect, then goes high again. S-register **S10** defines how long the DCD signal remains low after a disconnect.  
 Default: **&C1** (DCD normal)  
 Description: The **&Cn** command controls the behavior of the DCD (Data Carrier Detect) signal (pin 8 on the RS232E/V.24 interface). Normally, DCD goes high when the TA establishes a connection, and drops when the connection is lost. However, you can also force DCD to remain high at all times, or to remain high except for a brief drop following a disconnect.

Command: **&Dn**  
 Function: DTR Control  
 Unit: Decimal ASCII code  
 Values: n=0—The TA ignores the DTR signal.  
 n=1—When DTR goes low, the TA exits data mode and re-enters AT command mode.  
 n=2—If DTR goes low when the TA is online, then the TA hangs up, returns to command mode, and disables auto-answer. If the TA is offline, it neither answers nor dials while DTR is low.  
 n=3—When DTR goes low, the TA resets the data port and disables auto-answer. If DTR goes low when the TA is online, then the TA hangs up, resets the active configuration to the stored configuration, and disables auto-answer.  
 n=4—Ignore DTR only when answering a data call. If DTR is low when an incoming data call is present, then the TA will answer the call. If DTR goes high during that call, nothing will happen. However, if DTR goes high and then drops for the minimum time specified by **S25**, then the call will be disconnected just as it would with **&D1**. **&D4** is the same as **&D1**, except that **&D4** can answer a data call without DTR and DTR can remain low for the duration of the call, but if DTR goes high, then **&D4** will behave like **&D1**.  
 Default: **&D1** (exit data mode and re-enter AT command mode)  
 Description: The **&Dn** command controls how the TA responds to the DTR (Data Terminal Ready) signal on pin 20 of the RS232E/V.24 interface. A high DTR signal tells the TA that the connected computer is ready to communicate. If a call is to be accepted while DTR is low, then the TA must be configured to ignore DTR (**&D0** or **&D4**). If this configuration setting is not made, the TA rejects incoming calls until DTR is high when the call is received.

Command: **\$Dn**  
 Function: Persistent DTR Dialing  
 Unit: Decimal ASCII code  
 Values: n=0—disable,  
 n=1—enable  
 Default: **\$D0** (disabled)  
 Description: The **\$Dn** command enables or disables Persistent DTR Dialing (PDD). PDD causes the terminal adapter to automatically and continuously redial stored telephone number 0 when the port has no active calls and DTR is high. The delay after a call disconnects (returning to the idle state) yet DTR is still high is controlled by S-register **S80**. Also, once DTR changes from low to high, then a delay set by **S80** will

occur before dialing begins. See the description of S-register **S80** for further details regarding its interaction with **\$Dn**.

Command:	<b>&amp;En</b>
Function:	Flow Control
Unit:	Decimal ASCII code
Values:	<p>n=3—Disable flow control by the TA.</p> <p>n=4—Hardware flow control. <b>&amp;E4</b> causes the TA to use the CTS signal on pin 5 of the RS232E/V.24 interface to regulate flow control. When CTS goes low, data flow from the computer is suspended until CTS goes high again. This method works with pacing, which uses the RTS signal on pin D. Hardware flow control cannot be enabled unless an error correction protocol is selected.</p> <p>n=5—XON/XOFF flow control. This is an in-band method, in which the XON and XOFF characters (^Q and ^S respectively) are inserted into the data stream, rather than using separate control lines. When an XOFF character is detected, the data stream is suspended until an XON character is detected. The drawback to this method is that some files may contain these characters, causing the file transfer to be suspended indefinitely.</p> <p>n=6—When XON/XOFF pacing is active, the TA responds to and discards the XON/XOFF characters from the computer.</p> <p>n=7—When XON/XOFF pacing is active, the TA responds to the XON/XOFF characters and passes them through the communications link to the remote device, thereby pacing the remote terminal adapter as well.</p> <p>n=12—Disable pacing.</p> <p>n=13—Enable pacing.</p>
Default:	<b>&amp;E4, &amp;E6, &amp;E13</b>
Description:	The <b>&amp;En</b> command selects the method by which the TA controls the flow of data to and from the computer, to prevent either device from accepting data faster than it can handle. The TA provides flow control in both directions. When the TA halts data flow, it is termed <i>flow control</i> ; when the computer halts data flow, it is termed <i>pacing</i> .
Command:	<b>&amp;Rn</b>
Function:	CTS Control
Unit:	Decimal ASCII code
Values:	<p>n=0—CTS acts normally; that is, it follows RTS.</p> <p>n=1—CTS is forced high, but still provides online flow control.</p> <p>n=2—CTS is forced high, but it drops on disconnect for the period of time set by <b>S10</b>. CTS still provides flow control when the TA is online.</p>
Default:	<b>&amp;R1</b> (CTS forced high)
Description:	The <b>&amp;Rn</b> command lets you control the state of the CTS (Clear to Send) signal on the RS232E/V.24 interface. Normally the CTS signal follows the state of the RTS signal when the TA is online.
Command:	<b>&amp;RFn</b>
Function:	CTS/RTS Interaction Control
Unit:	Decimal ASCII code
Values:	n=0 (CTS follows RTS when on-line), n=1 (CTS is independent of RTS when on-line)
Default:	<b>&amp;RF1</b> (CTS is independent of RTS when on-line)
Description:	In normal operation, Clear-to-Send (CTS) follows Request-to-Send (RTS) when the modem is on-line. In other words, if RTS goes off, CTS goes off in response. The <b>&amp;RF0</b> command enables CTS to follow RTS. In some applications, however, it may be necessary for CTS to operate independently of RTS. <b>&amp;RF1</b> allows CTS to operate independently regardless of the state of RTS, and is the factory default. If this is the case, refer to the &R command for control of the Clear-to-Send signal. The <b>&amp;RFn</b> command has effect only when using <b>&amp;R0</b> (CTS acts normally—CTS follows RTS).

Command: **&Sn**  
 Function: DSR Control  
 Unit: Decimal ASCII code  
 Values: n=0—DSR is always high.  
 n=1—DSR acts normally; that is, it follows the state of the CD signal, which goes high when the TA detects a carrier signal, and goes low when the carrier signal is lost.  
 n=2—DSR is always high, except on disconnect, when it drops for the period of time set by S10 and then goes high again.  
 Default: **&S1** (DSR normal)  
 Description: The **&Sn** command controls the state of the DSR (Data Set Ready) signal on the RS232E/V.24 interface. A high DSR signal indicates to the computer that the TA is ready to transmit data.

Command: **!SW**  
 Function: Switch Serial Port Control to TA  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: The **!SW** command switches the serial port control to the TA. If the TA was already in control of the serial port, then the TA will simply report *OK*. Once the switch is complete the port will report *OK*. This command should be the only command given per AT command line. For example, only give the command **AT!SW<CR>**. Results for commands on the line following **!SW** may not be properly handled especially if switching from the modem to the TA.

Command: **\*!SW**  
 Function: Switch Serial Port Control to Modem  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: The **\*!SW** command switches the serial port control to the modem. If the modem was already in control of the serial port, then the modem will simply report *OK*. Once the switch is complete the port will report *OK*. This command should be the only command given per AT command line. For example, only give the command **AT\*!SW<CR>**. Results for commands on the line following **\*!SW** may not be properly handled especially if switching from the TA to the modem.

Command: **#Xn**  
 Function: Send Multiple Xoff Characters  
 Unit: Decimal ASCII code  
 Values: n=0—One Xoff character sent until the buffer reaches the Xon level  
 n=1—Multiple Xoff characters sent for every character received after buffer reaches the full level.  
 Default: **#X0**  
 Description: The **#Xn** command allows the TA to send either a single or multiple Xoff characters to exert flow control to the computer/terminal. The **#X0** command causes one Xoff to be sent until the TA's buffer reaches the Xon level. The **#X1** command causes an Xoff to be sent for every character received after the TA reaches its full buffer level.

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### D.1.5 General Configuration Commands

Command:	<b>@CONFIG</b>
Function:	Configuration Menu
Unit:	n/a
Values:	n/a
Default:	n/a
Description:	The <b>@CONFIG</b> command starts the TA's internal configuration menus, which you can then use to customize the TA's configuration for your particular application. <b>AT@CONFIG&lt;CR&gt;</b> must be entered while in a communication program's terminal mode—it cannot be given as an extra command to a non-terminal application. There is help information in the configuration menu and there are also on-screen instructions. The ESCAPE key can be used in place of typing "X" or "EXIT" to exit the configuration menu. When finished configuring the TA, upon exiting a prompt will ask whether or not the configuration is to be saved. A "y", "Y", "n", or "N" is required as input. A "y" or "Y" will save the configuration (same as the <b>&amp;W0</b> command). An "n" or "N" will not save the configuration nor will it undo any changes made while in the configuration menu. If there was a previous profile saved and changes were made by mistake and are to be undone, then give the TA the <b>AT*FS1&lt;CR&gt;</b> command or turn off the TA and turn it back on. The previous stored profile will be restored upon reset or power-up.
Command:	<b>En</b>
Function:	Command Mode Echo
Unit:	Decimal ASCII code
Values:	n=0—Echo off, n=1—Echo on
Default:	<b>E1</b> (Echo on)
Description:	Normally, when you enter commands on the keyboard, the TA echoes the characters back to the computer or terminal, where they are displayed on the monitor. Use the <b>En</b> command to turn this feature on and off.
Command:	<b>%En</b>
Function:	Escape Sequence Options
Unit:	Decimal ASCII code
Values:	ESCAPE METHOD n=0—Do not escape. n=1—"+++" escape method. n=2—<BREAK> escape method. n=3—Both "+++" and <BREAK> escape methods. ESCAPE RESPONSE n=4—Disable OK response to "+++". n=5—Enable OK response to "++".
Default:	<b>%E1</b> and <b>%E4</b>
Description:	By default, the TA responds only to the "+++" escape method. However, you can use the <b>%En</b> command to set the TA to respond only to the <BREAK> method, to respond to either the "+++" or the <BREAK> method, or to ignore both methods and not escape. If the escape method is enabled (not <b>%E0</b> ), then the escape response (OK) is given if enabled by <b>%E5</b> . For example, <b>%E1 %E5</b> enables the "+++" escape method and OK response to "++".

Command:	<b>&amp;Fn</b>
Function:	Load Factory Profile
Unit:	Decimal ASCII code
Values:	n=0—Profile 0 (Modem-like operation), n=2—Profile 2 (V.120 async operation), n=3—Profile 3 (X.75 async operation), n=4—Profile 4 (PPP async operation), n=5—Profile 5 (HDLC async operation)
Default:	<b>&amp;F0</b> (Modem-like operation)
Description:	For quick setup, the TA includes several Factory Profiles, each of which contains configuration parameters for a specific type of port operation. You can load a Factory Profile into active memory by using the command <b>&amp;Fn</b> , in which <i>n</i> is the number of the profile you wish to load. If you wish, you can then customize the profile and store it, using the <b>&amp;WO</b> command, so that it loads automatically on power-up or reset. The Factory Profiles are stored in permanent memory and are not user-configurable. (See Section 6.6)
Command:	<b>%Mn</b>
Function:	Management Mode
Unit:	Decimal ASCII code
Values:	n=0 (disable), n=1 (enable)
Default:	<b>%M0</b> (disabled)
Description:	Management mode is for use with a management agent. When management mode is enabled ( <b>%M1</b> ) the DSR mode ( <b>&amp;Sn</b> ) setting is overridden. DSR will be turned off when in command mode and off-line. DSR will be turned on when in data mode or on-line. <b>IHn</b> is set to a minimum of 5 seconds ( <b>IH5</b> ) and <b>*IHn</b> is set to a minimum of 5 seconds ( <b>*IH5</b> ).
Command:	<b>Qn</b>
Function:	Quiet Mode
Unit:	Decimal ASCII code
Values:	n=0—disable, n=1—enable
Default:	<b>Q0</b> (disable quiet mode, enable result codes)
Description:	The <b>Qn</b> command controls whether the TA sends result codes to the computer/terminal. When quiet mode is disabled ( <b>Q0</b> ), then result codes are given. When quiet mode is enabled, the result codes are suppressed. Use the <b>Vn</b> command to select the format of the result codes when quiet mode is disabled ( <b>Q0</b> ).
Command:	<b>Sr=n</b>
Function:	Set S-register
Unit:	Varies
Range:	r varies; n varies
Default:	n/a
Description:	Use the <b>Sr=n</b> command to set the value of an S-register, where <i>r</i> is the number of the S-register, and <i>n</i> is the value you want to set. For example, <b>ATS7=60&lt;CR&gt;</b> sets S-register 7 to 60. Unsupported S-registers ( <i>r</i> ) report <b>OK</b> without any numbers. Supported S-registers ( <i>r</i> ) that are given a setting ( <i>n</i> ) that is not valid return an <b>ERROR</b> message. The <b>L6</b> command gives a summary of all S-registers and their current settings. Section D.2 contains the complete list of S-registers and their descriptions. Table D.6 gives a summary of the available S-registers.

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Command:	<b>Sr?</b>
Function:	Read S-register
Unit:	Varies
Range:	r varies
Default:	n/a
Description:	Use the <b>Sr?</b> command to read the value of an S-register, where <i>r</i> is the number of the S-register. For example, <b>ATS7?&lt;CR&gt;</b> gives the current setting of S-register 7. The <b>L6</b> command gives a summary of all S-registers and their current settings. Section D.2 contains the complete list of S-registers and their descriptions. Table D-2 gives a summary of the available S-registers.
Command:	<b>Vn</b>
Function:	Terse/Verbose Result Codes
Unit:	Decimal ASCII code
Values:	n=0—enable terse result codes, n=1—enable verbose result code
Default:	<b>V1</b> (Verbose)
Description:	Use the <b>Vn</b> command to control whether the TA's result codes are displayed as digits (terse) or as words (verbose). Use the <b>Qn</b> command to enable or disable the display of result codes.
Command:	<b>&amp;Wn</b>
Function:	Store Active Profile
Unit:	Decimal ASCII code
Values:	n=0—Stores all current AT command and S-register values in nonvolatile random access memory (NVRAM) and configures the TA so that it reads your custom settings in NVRAM when the modem is turned on or when it is reset with the <b>Z</b> command. (The <b>&amp;F</b> reset command continues to read the factory default settings in ROM.) n=1—Erases custom settings in NVRAM the next time the TA is turned off or reset, causing the TA to read the factory default settings in ROM whenever it is turned on or reset. n=2—Clear all defaults (TA port 1 and TA port 2).
Default:	<b>&amp;W1</b> (Use factory default profile)
Description:	The <b>&amp;Wn</b> command stores your active profile, or configuration, in memory so you won't lose your custom settings when you turn off the TA or reset it.
Command:	<b>Xn</b>
Function:	Connect Messages
Unit:	Decimal ASCII code
Values:	n=0—Enables messages <i>OK</i> , <i>CONNECT</i> , <i>RING</i> , <i>NO CARRIER</i> , and <i>ERROR</i> (terse result codes 0-4). n=1—Enables all messages except <i>BUSY</i> (terse result codes 0-5, 10-14, 17-19, 28, and 32). If a call is placed to a busy line, the message <i>NO CARRIER</i> is displayed. n=2—Enable all messages (terse result codes 0-5, 7, 10-14, 17-19, 28, and 32). n=3—Enables all messages except it does not print the protocol messages. n=4—Disable printing Calling Line Identification (CLI) at the end of the <i>CONNECT</i> message line. This command does not affect <b>X0</b> , <b>X1</b> , or <b>X2</b> . n=5—Enable printing Calling Line Identification (CLI) at the end of the <i>CONNECT</i> message line. This command does not affect <b>X0</b> , <b>X1</b> , or <b>X2</b> .
Default:	<b>X2</b> (Enable all messages) and <b>X4</b> (Disable printing CLI with <i>CONNECT</i> message)
Description:	Use the <b>Xn</b> command to select which result code messages the TA sends to the computer/terminal.

Command: **Z**  
 Function: Reset to Stored Profile  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: The **Z** command resets the TA to its current power-up profile and clears the command buffer. The result is the same as turning the TA off and on. When you type **ATZ<CR>**, the state of the **&W** command determines where the default values originate. **&W0** defaults come from the customized configuration in NVRAM, and **&W1** defaults come from the factory default configuration in ROM. Because **Z** clears the command buffer, it must be the last command in a command string; normally it is issued by itself: **ATZ<CR>**. Note that whereas the **&F0** reset command always restores the factory default profile, the **Z** reset command restores either the factory default or the stored profile, depending on how the **&W** command is set.

Command: **&Zn=x**  
 Function: Store Telephone Number  
 Unit: Decimal ASCII code  
 Values: n=0-9; x=dial string  
 Default: n/a  
 Description: The **&Zn=x** command lets you store a telephone number in a memory register for faster dialing. To store a number, type **&Z**, the register number (0-9) where you want to store the number, the = character, and the dialing string that you want stored; then press **<CR>**. The dialing string can have up to 25 characters. To read a specific stored number, type **AT&Zn?** (e.g., **AT&Z4?**) where *n* is the number of the register you want to read. To display the list of all numbers stored in memory, type **ATL<CR>**.

Command: **!Z=n**  
 Function: Rate Adaption/Data Protocol  
 Unit: Decimal ASCII code  
 Values: n=**5**—V.120 (async, error detection, error correction)  
           n=**7**—HDLC (async, error detection)  
           n=**9**—PPP (async, error detection)  
           n=**12**—X.75 (async, error detection, error correction)  
 Default: **!Z=9** (PPP)  
 Description: The **!Z=n** command selects the rate adaption protocol used to communicate with another TA. The local and remote TAs must be set to the same protocol for communication to take place, unless the remote TA supports automatic protocol detection. See **S52** for a description of automatic protocol detection supported by this TA. Some protocols support error correction, such as V.120 and X.75. Other protocols, such as PPP, rely on the upper layers (the computer) to handle error correction. The TA will allow reception of V.110 calls which will be routed directly to the modems. See the description for S-register **S83** for further information regarding routing of V.110 calls.



### D.1.6 Digital (Data) Call Commands

Use these commands to make or configure digital (data) calls.

Command: **A**  
 Function: Answer Digital Call  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: The **A** command forces the TA to answer an incoming digital call. To cause the TA to auto-answer, set register **SO** to a value higher than 0.

Command: **Dn**  
 Function: Dial Digital Number  
 Unit: ASCII  
 Values: n=dial string containing **0-9**, **\*\***, **#**, **&**, **+**, **!**, **-**, **(**, **)**, or **,**  
 Default: No dial string  
 Description: The **D** command causes the TA to dial a digital telephone number (e.g., **ATD785-3500<CR>**). The dial string can contain up to 80 characters.

Command: **DSn**  
 Function: Dial Stored Number  
 Unit: Decimal ASCII code  
 Values: n=**0-9**  
 Default: **DS0** (Dial stored number 0)  
 Description: To dial a stored telephone number, type **DSn** in terminal mode, where *n* is the location of the number you wish to dial. For example, **ATDS3<CR>** dials a telephone stored in memory register 3 location. Stored numbers can be reviewed by giving the command **ATL<CR>**. Numbers can be stored by the use of the **&Zn=x** command.

Command: **Hn**  
 Function: Hang Up Digital Call  
 Values: n=**0**—Go on-hook (hang up)  
 n=**1**—Go off-hook  
 Default: **H0**  
 Description: The **H** command forces the TA to go off-hook (to take control of the telephone line) or to go on-hook (hang up). Since the TA goes off-hook automatically when it dials, the **Hn** command is normally used only to hang up. To hang up, you must first escape to command mode (**+++AT<CR>**), then type **ATH<CR>** or **ATH0<CR>**. You can also include the hang up command in the escape sequence: **+++ATH<CR>**.

Command: **!Hn**  
 Function: Digital Call Hold-Off Time Unit: 1 second  
 Values: n=**0** (disable),  
 n=**1-255** (1-255 seconds)  
 Default: **!H0** (disabled)  
 Description: When a digital call disconnects a timer will be installed that will hold off incoming digital calls for the given amount of time (*n*) for that digital port. Digital calls that are received by that port while calls are being held off will not be rejected nor will RING messages be given. Rather the digital call will be held in an alerting state until **!Hn** times out at which point the call will begin the normal ringing process. Digital calls originated from that port while the **!Hn** timer is running will abort the timer and the call will go out immediately. This command can be very useful for certain RAS environments that require at least 1 second to initialize a port after a call has disconnected (such as Citrix and Novell). See the troubleshooting section below for more information about the use of this feature.

Command: **O**  
 Function: Return Online  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: The **O** command returns the TA to online mode from the online command mode. When the TA makes a data connection, it enters online data mode. The TA typically remains in this mode until it receives an escape sequence or until the call is ended. When it detects an escape sequence, the TA enters online command mode, in which it can accept AT commands while retaining the online connection. To return the TA to online mode from the online command mode, enter the command **ATO<CR>**.

### D.1.7 Analog (Modem) Call Commands

Use these commands to make or configure analog (POTS) calls.

Command: **\*An**  
 Function: Answer Analog Call  
 Unit: Decimal ASCII code  
 Values: n=0 (Analog Port 0)  
           n=1 (Analog Port 1)  
 Default: **\*An** (n=TA port number which command is given)  
 Description: The **\*An** command forces the TA to answer an incoming analog call on analog port *n*. If *n* is not specified, then *n* is assumed to be 0.

Command: **\*Bn**  
 Function: Send Analog Call Digit  
 Unit: ASCII  
 Values: n=0-9,A,B,C,D,\*,#  
 Default: n/a  
 Description: The **\*Bn** command forces the TA to send a dial digit to the analog port associated with the command port this command is given (Analog Port 0).

Command: **\*Dn**  
 Function: Dial Analog Number  
 Unit: ASCII  
 Values: n=dial string composed of 0-9,A,B,C,D,\*,#  
 Default: No dial string  
 Description: The **\*Dn** command causes the TA to dial an analog telephone number (e.g., **AT\*D785-3500<CR>**). The dial string can contain up to 80 characters.

Command: **\*Hn**  
 Function: Hang Up Analog Call  
 Unit: Decimal ASCII code  
 Values: n=0 (Analog Port 0),  
           n=1 (Analog Port 1)  
 Default: **\*Hn** (n=TA port number which command is given)  
 Description: The **\*Hn** command spoofs the TA into believing the analog port went on-hook (hung up).

Command: **\*!Hn**  
 Function: Analog Call Hold-Off Time  
 Unit: 1 second  
 Values: n=0 (disable),  
           n=1-255 (1-255 seconds)  
 Default: **\*!H0** (disabled)  
 Description: When an analog call disconnects a timer will be installed that will hold off incoming

analog calls for the given amount of time (*n*) for that analog port. Analog calls that are received by that port while calls are being held off will not be rejected nor will a ring be given. Rather the analog call will be held in an alerting state until *\*!Hn* times out at which point the call will begin the normal ringing process. Analog calls originated from that port while the *\*!Hn* timer is running will abort the timer and the call will go out immediately. This command can be very useful for certain RAS environments that require at least 1 second to initialize a port after a call has disconnected (such as Citrix and Novell). See the troubleshooting section below for more information about the use of this feature.

## D.2 S-Registers

S-registers are sections of memory in which values are stored that affect how the TA operates. S-registers are so-called because each has a name that begins with the character S. Use the **Sr=n** command to assign a value to an S-register or use the **Sr?** command to read the current value of an S-register. S-registers are stored in non-volatile RAM (NVRAM) by using the **&WO** command. **ATZ<CR>** restores S-registers to values stored in NVRAM if any were stored using the **&WO** command, otherwise they revert to factory default settings in ROM. Table D-2 summarizes the available S-registers and their function.

**Table D-2. S-Register Summary**

S-Register	Function
S0	Rings Until Answer
S1	Ring Count
S2	Escape Character
S3	Carriage Return Character
S4	Line Feed Character
S5	Backspace Character
S7	Wait for Connection (Abort Timer)
S8	Pause Time for Comma
S10	DCD Drop Time
S25	DTR Drop Time
S29	On-line Inactivity Timer Period
S30	On-line Inactivity Timer
S32	Escape Sequence Timeout
S34	Maximum Escape Sequence Length
S50	Caller Line ID (CLI)
S52	Auto-Protocol Detection
S53	Maximum X.75 Buffer Size
S54	B-Channel Origination Rate
S55	Information Transfer Capability for Analog Port Calls
S56	Calling Party Number Information Element Settings
S57	Called Party Number Information Element Settings
S79	Reset Modem after Disconnect
S80	Persistent DTR Dialing Delay
S81	Link Setup Timeout
S82	Delay Before Trying V.110
S83	Modems Handle V.110
S84	Data to Terminal Delay
S85	Data to B-channel Delay
S87	INS64 Analog Call Origination Delay
S89	Modem Ring/Dialtone Information
S154	B-Channel Answer Rate

S-Register: **S0**  
 Usage: S0=n; S0?  
 Function: Number of Rings Until Answer  
 Unit: 1 ring  
 Range: n=**0-255** (0-255 rings)  
 Default: **1** (1 ring)  
 Description: **S0** sets the number of rings the TA waits for before it answers and begins its connect sequence. **S0=0** turns off the ability to automatically answer a call. **S0=1** causes the TA to automatically answer after 1 ring. Note that if the **S0** value is set too high, the calling device may time out before the TA answers the call. For auto-answer, **S0** must have a non-zero value, DTR must be high (**&Dn** command), and the TA must be offline.

S-Register: **S1**  
 Usage: S1?  
 Function: Ring Count  
 Unit: 1 ring  
 Range: n=**0-255** (0-255 rings)  
 Default: **0** (0 rings)  
 Description: **S1** counts the number of rings that have occurred, up to a maximum of 255. It is a read-only register and is seldom, if ever, used in typical operation. If you set **S1** to a value other than its default value of zero, or if the value is increasing with rings, this new value remains stored in **S1** for eight seconds after the last ring is counted, after which time the value reverts to zero.

S-Register: **S2**  
 Usage: S2=n; S2?  
 Function: Escape Character  
 Unit: Decimal ASCII code  
 Range: n=**0-127**  
 Default: **43** (+)  
 Description: **S2** specifies the character used by the TA to escape from data mode and return to command mode.

S-Register: **S3**  
 Usage: S3=n; S3?  
 Function: Carriage Return Character  
 Unit: Decimal ASCII code  
 Range: n=**0-127**  
 Default: **13** (^M)  
 Description: **S3** specifies the character used by the TA to indicate the end of a command line.

S-Register: **S4**  
 Usage: S4=n; S4?  
 Function: Line Feed Character  
 Unit: Decimal ASCII code  
 Range: n=**0-127**  
 Default: **10** (^J)  
 Description: **S4** specifies the character used by the TA to indicate the end of a status message.

S-Register: **S5**  
 Usage: S5=n; S5?  
 Function: Backspace Character  
 Unit: Decimal ASCII code  
 Range: n=**0-32, 127**  
 Default: **8** (^H)  
 Description: **S5** specifies the character used by the TA to delete the previous character in the command line.

- S-Register: S7**  
**Usage:** S7=n; S7?  
**Function:** Wait for Connection (Abort Timer)  
**Unit:** 1 second  
**Range:** n=**0-255** (0-255 seconds for all switch types except INS64)  
n=**0-50** (0-50 seconds for INS64 switch type)  
**Default:** **45** (45 seconds)  
**Description:** **S7** sets the Abort Timer delay time, which is the length of time the TA waits for a connection after dialing. If no connection is established during the specified time, the TA ends the call. The INS64 switch type limits the maximum delay time to 50 seconds or less. All other switch types allow up to 255 seconds of delay.
- S-Register: S8**  
**Usage:** S8=n; S8?  
**Function:** Pause Time for Comma  
**Unit:** 1 second  
**Range:** n=**0-255** (0-255 seconds)  
**Default:** **2** (2 seconds)  
**Description:** **S8** sets the length of the pause caused by a comma inserted in a dialing command. The default setting is 2 seconds, where each unit is one second. S8 may be set for up to 255 seconds.
- S-Register: S10**  
**Usage:** S10=n; S10?  
**Function:** DCD Drop Time  
**Unit:** 50 ms  
**Range:** n=**0-254** (0-12.75 seconds),  
n=**255** (do not disconnect)  
**Default:** **20** (1 second)  
**Description:** **S10** sets the time after a carrier signal is lost before the TA disconnects. (The **&C2** command must be in effect.) The default setting is one second. Maximum delay is 12.75 seconds (**S10=254**). Set **S10** to 255 to cause the TA not to disconnect with loss of carrier.
- S-Register: S25**  
**Usage:** S25=n; S25?  
**Function:** DTR Drop Time  
**Unit:** 100 ms  
**Range:** n=**0** (50ms),  
n=**1-255** (100ms-25.5s)  
**Default:** **5** (500ms)  
**Description:** **S25** sets the time that DTR must remain low before the TA disconnects. The **S25** unit value for 0 is 50 ms. For values from 1 through 255, the unit value is 100 ms.
- S-Register: S29**  
**Usage:** S29=n; S29?  
**Function:** On-line Inactivity Timer Period  
**Unit:** 0.25 seconds  
**Range:** n=**0**—does not disconnect  
n=**1-255** (0.25-63.75 seconds)  
**Default:** **240** (60 seconds)  
**Description:** **S29** sets the on-line inactivity timer period and affects the on-line inactivity timer **S30** by adjusting its unit of time. For example, this allows the inactivity of data calls to be timed down to 0.25 seconds and if no data is received within 0.25 seconds the data call will disconnect. This is useful for quick connect-disconnects or for continuous connect-disconnect cycles when combined with the use of Persistent DTR Dialing (PDD). By default the period is 60 seconds (1 minute).

S-Register: **S30**  
 Usage: S30=n; S30?  
 Function: On-line Inactivity Timer  
 Unit: (n \* **S29 \*0.25**) seconds (**S29=240** by default)  
 Range: n=0 (does not disconnect),  
 n=1-255 (1-255 minutes by default (**S29=240**))  
 Default: **0** (does not disconnect)  
 Description: **S30** causes the TA to disconnect a data connection if no data is transmitted or received for the specified time. It will NOT cause an analog call (voice/modem/fax) to disconnect. The timer will restart any time a data character is passed through the serial port (either sent or received). The inactivity timer is disabled by setting **S30=0** or **S29=0**. By default **S30=0**, so data calls are not disconnected if sitting idle.

S-Register: **S32**  
 Usage: S32=n; S32?  
 Function: Escape Sequence Timeout  
 Unit: 100 ms  
 Range: n=0-255 (0-25.5 seconds)  
 Default: **20** (2 seconds)  
 Description: **S32** sets the time allowed in an escape sequence from the receipt of the A in AT to the receipt of the carriage return. If the **S32** time interval expires before you press ENTER, the escape sequence ends. The default time is 2 seconds.

S-Register: **S34**  
 Usage: S34=n; S34?  
 Function: Maximum Escape Sequence Length  
 Unit: 1 character  
 Range: **0-10** (0-10 characters)  
 Default: **2** (2 characters after escape sequence)  
 Description: **S34** sets the maximum character length of the escape sequence, not including **+++AT**. For example a character length of **S34=2** allows 2 characters after **+++AT** (e.g., **+++ATH0**). Conversely, an invalid escape sequence (too many characters placed in the command string) would be passed through as data (e.g., **+++AT112**). The maximum length of the escape sequence is 10 characters.

S-Register: **S50**  
 Usage: S50=n; S50?  
 Function: Caller Line ID (CLI)  
 Unit: Decimal ASCII code  
 Range: n=0 (disable), n=1 (enable with first RING only), n=2 (enable with all RING messages)  
 Default: **0** (disabled)  
 Description: **S50** sets whether the mechanism for identifying the two endpoints of a connection is enabled or disabled. Since RING messages only appear for ISDN digital calls, the CLI feature does not define a means of conveying Calling Party information to the terminal for analog calls. CLI information is included only with the first RING message for a given incoming call when **S50=1**. For example:  
 RING  
 FM: 5552000 TO: 5551000  
 RING  
 CLI information is included with all RING messages for a given incoming call when **S50=2**. For example:  
 RING  
 FM: 5552000 TO: 5551000  
 RING  
 FM: 5552000 TO: 5551000

If the Calling Party Number information is not included in the incoming SETUP message, then the RING message appears as follows:

RING  
TO: 5551000

If the Called Party Number information is not included in the incoming SETUP message, then the RING message appears as follows:

RING  
FM: 5551000

If neither the Called Party Number nor Calling Party Number is included in the incoming SETUP message, then the RING message contains no additional information.

- S-Register: **S52**  
Usage: S52=n; S52?  
Function: Auto-Protocol Detection  
Unit: Decimal ASCII code  
Range: n=0 (Disable),  
n=1 (Detect),  
n=2 (Detect and Select)  
Default: 1 (Detect)  
Description: **S52** enables or disables the ability to identify the reception of V.110, V.120, X.75, or PPP data calls. The TA determines the type of call by checking for protocol information in the SETUP message or by matching protocol information received on the B-channel once connected if no protocol information is available in the SETUP message. Once the protocol is determined, the TA will switch its data protocol to match. Upon disconnect the TA will revert its data protocol selection back to the protocol that was selected before the call was received when **S52=1** "Detect". If **S52=2** "Detect and Select", then the TA will not revert the protocol selection, rather it will keep the detected data protocol as the new protocol selection. "Detect and Select" is useful for applications where the TA receives a call and then the software performs callback. Callback calls should be made with the same protocol that was used by the client so "Detect and Select" enables this possibility. However, if an initialization string or **&Fn** command is given to the TA that changes the protocol after the disconnection, then "Detect and Select" will not be effective. Make sure no commands are given to the TA that will change the data protocol when using "Detect and Select" if callback is involved to ensure that the callback call uses the correct data protocol.
- S-Register: **S53**  
Usage: S53=n; S53?  
Function: Maximum X.75 Buffer Size  
Unit: 1 bytes  
Range: n=**6D-2048** (6D-2048 bytes)  
Default: **2048** (2048 bytes)  
Description: **S53** allows the maximum buffer size of an X.75 frame to be customized. Typically a smaller frame size is more compatible with software packages on a PC (such as HyperTerminal). Larger frame sizes introduce larger delay which some software cannot deal with appropriately.
- S-Register: **S54**  
Usage: S54=n; S54?  
Function: B-Channel Origination Rate  
Unit: Decimal ASCII code  
Range: n=0 (64Kbps, but use Progress Indicator IE)  
n=56 (56Kbps)  
n=**64** (64Kbps)  
Default: **0** (64Kbps, but use Progress Indicator IE)

Description: **S54** allows the ability to force the TA to originate digital calls with a 56Kbps or 64Kbps B-channel data rate. In some situations it is necessary to force a 56Kbps connection. Such a situation may occur when an originated call fails to connect because the end-to-end connection is not 64Kbps and the originating TA or the answering TA is not informed of this situation by the network. In some situations it is necessary to force a 64Kbps connection when the originating TA is first informed that the call changed 56Kbps but then later returned to the ISDN and switched back to 64Kbps. By default the TA will check for Progress Indicator Information Elements indicating changes in the routing of digital calls to determine whether the call needs to switch to 56Kbps or remain at 64Kbps.

S-Register: **S55**

Usage: S55=n; S55?

Function: Information Transfer Capability for Analog Port Calls

Unit: Decimal ASCII code

Range: n=1 (Speech, no progress indicator),  
n=2 (3.1KHz Audio, no progress indicator),  
n=17 (Speech, Origination address is Non-ISDN),  
n=18 (3.1KHz Audio, Origination address is Non-ISDN)

Default: 1 (Speech, no progress indicator)

Description: **S55** allows the ability to set the type of Information Transfer Capability for calls placed from the analog port either by a telephone, modem, or fax. Some Central Office switches keep track of the type of line each customer has and if that line is labeled as a data line (modem or fax), then it won't accept a speech call originated on that line. The 3.1KHz Audio Information Transfer Capability, however, is allowed on data lines (modem or fax) by most switches. **S55** also allows the user to indicate whether a progress indicator information element indicating that the origination address of the analog call is non-ISDN is sent with the SETUP message for the analog port call. This has been found to help analog port calls get through certain switches.

S-Register: **S56**

Usage: S56=n; S56?

Function: Calling Party Number IE Settings

Unit: Decimal ASCII code

Range: n=128 (Disable),  
n=129 (Send Calling Party Number IE using defaults) Otherwise, n=(Type of Number) + (Numbering Plan)  
\* Type of Number  
0—unknown,  
16—international,  
32—national,  
48—network specific,  
64—subscriber,  
96—abbreviated  
\* Numbering Plan  
0—unknown,  
1—ISDN/telephony,  
3—data,  
4—telex,  
8—national standard,  
9—private

Default: 128 (Disabled)

Description: **S56** modifies the value of Octet 3 of the Calling Party Number Information Element that is sent within the SETUP message for digital and analog (voice/modem/fax) calls. To set a specific number-type and numbering plan, select an option from the Type of Number section above and add its respective value to the respective value of



an option in the Numbering Plan section above. For example, a National/ISDN Calling Party Number IE would be **S56=33**, where 32 (national) + 1 (ISDN/telephony) = 33 (National/ISDN). If there is no Data DN/MSN 1 stored (for digital calls) nor Voice DN/MSN given (for voice/modem/fax calls), then no Calling Party Number IE will be sent. By default **S56=128** which means no Calling Party Number IE is sent. If **S56=129**, then the Calling Party Number IE will be sent (if the appropriate DN/MSN is stored) with the default Type of Number and Numbering Plan used for the given switch type.

- S-Register: **S57**  
 Usage: S57=n; S57?  
 Function: Called Party Number IE Settings  
 Unit: Decimal ASCII code  
 Range: n=**128** (Disable), Otherwise, n=(Type of Number) + (Numbering Plan)  
 Type of Number  
 0—unknown,  
 16—international,  
 32—national,  
 48—network specific,  
 64—subscriber,  
 96—abbreviated  
 Numbering Plan  
 0—unknown,  
 1—ISDN/telephony,  
 3—data,  
 4—telex,  
 8—national standard,  
 9—private  
 Default: **128** (disabled)  
 Description: **S57** modifies the value of Octet 3 of the Called Party Number Information Element that is sent within the SETUP message for a data call and within each INFORMATION message that is sent when dialing from the POTS port. Called Party Number Information Elements are sent only by the NET3, VN4, and INS64 switch types. To set a specific number-type and numbering plan, select an option from the Type of Number section above and add its respective value to the respective value of an option in the Numbering Plan section above. For example, a National/ISDN Called Party Number IE would be **S57=33**, where 32 (national) + 1 (ISDN/telephony) = 33 (National/ISDN). By default **S57=128** which means no Called Party Number IE is sent.
- S-Register: **S79**  
 Usage: **S79=n; S79?**  
 Function: Reset Modem After Disconnect  
 Unit: Decimal ASCII code  
 Range: n=**0** (Do not reset the modem),  
 n=**1** (Reset the modem)  
 Default: **0** (Do not reset the modem)  
 Description: **S79** allows control of whether the modems associated with the TA port given this command will reset the modem upon disconnection of the B-channel. The modem is reset upon disconnect simply to make sure the modem is functioning from a known state to reduce problems. Also, the modem may not know when the remote peer disconnects if the B-channel drops before proper disconnect signaling is recognized by the modem. Because of this, the modem may not disconnect for almost one minute and so resetting the modem when the B-channel disconnects reduces down-time for the modem. Refer to S-register **S-83** for a description of which TA ports affect which modem ports. Resetting a modem takes it out of service for about four seconds. Some operating systems and some applications have difficulty with the

modem being reset because of the change of the EIA serial signals and so disabling the reset may be required. By default, the TA does not reset the modems upon B-channel disconnection.

S-Register: **S80**  
 Usage: S80=n; S80?  
 Function: Persistent DTR Dialing Delay  
 Unit: 1 second  
 Range: n=0 (no delay),  
 n=1-255 (1-255 seconds)  
 Default: 0 (no delay) Description: Once DTR is detected as present (active high) and other conditions required for the TA to dial are met, a delay of **S80** seconds will occur before stored number 0 is dialed. Some conditions include the TA not being in the @CONFIG configuration menu, not having a data call present at the time, and Persistent DTR Dialing must be enabled. By default the TA will not delay before dialing when all conditions are satisfied.

S-Register: **S81**  
 Usage: S81=n; S81?  
 Function: Link Setup Timeout  
 Unit: 100ms  
 Range: n=0 (discard pending call),  
 n=1-255 (100ms-25.5s)  
 Default: 30 (3 seconds) for the INS64 switch type  
 10 (1 second) for all other switch types  
 Description: When all layers are down and no TEI's are assigned or the switch dropped the TEI's without informing the TA, then when there is an incoming call or the TA attempts to originate a call it must first bring up Layer 1, Layer 2, and request a TEI. If for some reason the switch does not respond to the request for a TEI or none of the layers come up successfully, then the TA should timeout and report NO CARRIER or NO DIALTONE. By default **S81** allows 3 seconds (INS64 switch type) or 1 second (all other switch types) for the link to set up. Typically the link is set up within 2 seconds for the INS64 switch type and 200ms for all other switch types.

S-Register: **S82**  
 Usage: S82=n; S82?  
 Function: Delay Before Trying V.110  
 Unit: 100ms  
 Range: n=5-255 (500ms-25.5s)  
 Default: 40 (4 seconds)  
 Description: **S82** was added to allow flexibility in the amount of time the TA is given to detect non-V.110 data protocols when answering a digital using Auto-Protocol Detection (**S52=1** or **S52=2**). By default there is a D-second period after connecting for the TA to detect the data protocol being used by the client. If V.110 support is available to the TA, then after **S82**\*100ms of not being able to determine the data protocol of the client the TA will assume that the call is V.110. However, some TAs do not send data on a B-channel within 4 seconds. If the client did not call in using V.110, then the TA will disconnect the call 10 seconds after switching to V.110. Increasing **S82** will eventually yield success.

S-Register: **S83**  
 Usage: S83=n; S83?  
 Function: Modems Handle V.110  
 Unit: Decimal ASCII code  
 Range: n=0 (disable),  
 n=1 (enable—modems handle V.110)  
 Default: 1 (enable—modems handle V.110)

Description: **S83** controls whether or not the modems will handle possible V.110 calls. If **S83=0**, then it will not be assumed that the modems support V.110 and the V.110 call will fail. Auto-protocol detection is required to be enabled on the TA port that corresponds to the modem port that is intended to answer V.110 calls. If the corresponding TA port is busy, then the call will roll over to the next TA port on the same BRI. The port setup is as follows:

Port 1—TA#1 Port 1 or Modem #1, BRI#1

Port 2—TA#1 Port 2 or Modem #2, BRI#1

Port 3—TA#2 Port 1 or Modem #3, BRI#2

Port 4—TA#2 Port 2 or Modem #4, BRI#2

Port 5—TA#3 Port 1 or Modem #5, BRI#3

Port 6—TA#3 Port 2 or Modem #6, BRI#3

For example, if Modem #1 is intended to answer V.110 calls, then **S83=1** must be given to TA#1 Port 1. By default the TA will send V.110 calls to the modems.

S-Register: **S84**

Usage: S84=n; S84?

Function: Data to Terminal Delay

Unit: 10ms

Range: n=0 (no delay),  
n=1-255 (10ms-2.55s)

Default: 0 (no delay)

Description: **S84** controls the delay time for data sent from the TA to the terminal. The timer for this S-register is started at the time the *CONNECT* message is printed. Any data received from the B-channel after the *CONNECT* message but before the timer expires is stored in a queue in the order in which it is received. Once the timer expires, any queued data will be sent to the terminal in the order in which it was received. This delay timer is useful for use with some applications that are not ready for to receive data too soon after the *CONNECT* message is given.

S-Register: **S85**

Usage: S85=n; S85?

Function: Data to B-channel Delay

Unit: 10ms

Range: n=0 (no delay),  
n=1-255 (10ms-2.55s)

Default: 0 (no delay)

Description: **S85** controls the delay time for data sent from the TA to the appropriate B-channel. The timer for this S-register is started at the time the *CONNECT* message is printed. Any data received from the terminal after the *CONNECT* message but before the timer expires is stored in a queue in the order in which it is received. Once the timer expires, all queued data will be sent to the appropriate B-channel in the order in which it was received.

S-Register: **S87**

Usage: S87=n; S87?

Function: En-bloc Analog Call Origination Delay

Unit: 100ms

Range: n=0-255 (0-25.5s)

Default: 10 (1 second)

Description: **S87** allows flexibility of the amount of time given to the period after a digit is dialed before an analog call is sent to the network for processing. **S87** is only used when the dialing method is En-bloc (**%A97=0**). When a device goes off-hook on the analog port, the TA generates a dial tone (rather than the network generating a dial tone). Once a digit is dialed, a timer is started. If another digit is received before the timer reaches the **S87** value, then the timer is reset. If the timer reaches the value determined by **S87**, then the TA assumes that no more digits are to be dialed and the TA will send the *SETUP* message with the dialed number to the network for

processing. By default the TA will not send the SETUP message until 1 second after the last digit is received from the device.

S-Register: **S89**  
 Usage: S89=n; S89?  
 Function: Modem Ring/Dialtone Information  
 Unit: Decimal ASCII code  
 Range: n=0 (standard ring/dialtone),  
 n=1 (indicates A-law or u-law)  
 Default: **1** (indicates A-law or u-law)  
 Description: The ring and dialtone signals sent to the modems indicate various types of information. In the case of analog calls, they may be used to indicate the type of coding required by the modem to properly communicate with the remote modem. The type of call may be A-law or u-law and depends on the switch type. Previous to **S89** a standard ring and dialtone were sent to the modem in which case the modem would answer or originate the call according to its coding setting (**S108=0** is u-law and **S108=1** is A-law for Lucent CSM). **S89** was added to bypass the need to manually set the type of coding (**S108**) in the modem when receiving or originating calls. With **S89** set to 1 (indicates A-law or u-law), then modem firmware newer than 2.10Q is required. If a modem call is attempted and the modem does not support the new A-law/u-law detection, then the modem will print *NO DIALTONE* when originating a call and it will print a *RING* when receiving a call. To resolve this, then set **S89=0** on all TA ports. This will cause the TA to revert to previous ring and dialtone signaling compatible with older modem firmware (2.06I, 2.09B, and 2.10Q).

S-Register: **S154**  
 Usage: S154=n; S154?  
 Function: B-Channel Answer Rate  
 Unit: Decimal ASCII code  
 Range: n=0 (64Kbps, but use Progress Indicator IE),  
 n=1 (64Kbps, ignore Progress Indicator IE, check Bearer Capability IE),  
 n=56 (56Kbps),  
 n=64 (64Kbps)  
 Default: **0** (64Kbps, but use Progress Indicator IE)  
 Description: **S154** allows the ability to force the TA to answer digital calls with a 56Kbps or 64Kbps B-channel rate. In some situations it is necessary to force a 56Kbps connection. Such a situation may occur when a call fails to connect because the end-to-end connection is not 64Kbps and the originating TA or the answering TA is not informed of this situation by the network. In some situations it is necessary to force a 64Kbps connection when the TA is first informed that the call changed to 56Kbps but then later returned to the ISDN and switched back to 64Kbps. It may be more likely that setting **S154=1** is the best solution to the "not end-to-end ISDN" message given by the network. In this case (**S154=1**), the TA will assume 64Kbps unless the Bearer Capability Information Element indicates a 56Kbps connection. The TA will then ignore all Progress Indicator Information Elements when **S154=1**. By default the TA will check for Progress Indicator Information Elements indicating changes in the routing of digital calls to determine whether the call needs to switch to 56Kbps or remain at 64Kbps.

### D.3 Result Codes

When the TA receives an AT command from the computer or terminal, it attempts to execute the command, then sends a status message to the computer or terminal that reports the result of the command. The TA provides you with several of these response messages, or *result codes*, which can be displayed on your monitor or intercepted and used by your communications software. Using the *Vn* command, you can select whether the result codes are *terse* (numbers) or *verbose* (words).

The TA's result codes are listed in the following table. Note that the speed of an ISDN B-channel is always either 56Kbps (CONNECT 56000) or 64Kbps (CONNECT 64000) unless the call is a V.110 call in which case the reported connection speed will be that of the V.110 network rate.

**Table D-3. Result Codes**

Terse	Verbose	Definition
0	OK	The TA executed the command without error.
1	CONNECT	The TA has established an ISDN connection.
2	RING	The TA has detected a ring caused by an incoming call.
3	NO CARRIER	The TA did not detect a carrier within the time allotted by register <b>S7</b> .
4	ERROR	There was an error in the AT command.
6	NO DIALTONE	The TA has a poor connection to the ISDN network.
7	BUSY	The TA has detected a busy signal.
56	CONNECT 56000	The TA has connected at 56000 bps.
64	CONNECT 64000	The TA has connected at 64000 bps.
P	/PPP	The TA is using the Point-to-Point protocol.
V	/V.120	The TA is using the V.120 rate adaption protocol.
X	/X.75	The TA is using the X.75 rate adaption protocol.
H	/HDLC	The TA is using the HDLC protocol.

## D.4 Troubleshooting the TA

### D.4.1 Specific Troubleshooting Situations

**SITUATION 1:** The *!Hn* and *\*!Hn* commands can be very useful for certain RAS environments that require at least 1 second to initialize a port after a call has disconnected (such as Citrix and Novell). For example, when a call disconnects, Citrix and Novell will begin initializing the port that just disconnected. However, it typically takes more than 1 second and during that time a call may be received by the digital or analog port. When this happens, Citrix and Novell do not answer the call nor do they finish the initialization process. To prevent this problem, setting *!H5* and/or *\*!H5* will set the TA to hold of digital and/or analog calls for 5 seconds after the respective port(s) disconnect(s). This should give enough time for the digital and/or analog port to be initialized by Citrix or Novell and enter the “waiting for a call” state.

### D.4.2 Debugging/Logging/Troubleshooting Commands

The AT commands in this section can be used in attempting to troubleshoot or debug a current problem. Some commands may be enhanced or limited by the debugging/logging/troubleshooting S-registers described in section D.4.3.

**Table D-4. Debugging/Logging/Troubleshooting Command Summary**

<b>AT Command</b>	<b>Function</b>
>Dn	Embedded Protocol Analyzer (EPA)
*FSn	Reset TA
*Ln	Fatal Error Information
>LOG	Display Logging Buffer Contents
>Sn	Logging Variables
>TIME	Display Current Timestamp
*V	Various State Information
Command:	<b>&gt;Dn</b>
Function:	Embedded Protocol Analyzer (EPA)
Unit:	Decimal ASCII code
Values:	ANALYZER/DECODER COMMANDS n=0—Displays B-channel data using V.120 decoder n=1—Displays Layer 2 & 3 data using Q.921 & Q.931 decoders n=2—Displays Layer 2 data using Q.921 decoder n=3—Displays complete Layer 3 data using long-form Q.931 decoder n=38—Displays Layer 3 data using short-form Q.931 decoder with hex data n=39—Displays Layer 3 data using short-form Q.931 decoder n=4—Displays B-channel data using X.75 decoder n=5—Displays Asynchronous Port data using PPP decoder n=51—Displays Asynchronous Port data as raw asynchronous PPP data n=6—Displays B-channel data using PPP decoder n=61—Displays B-channel data as raw synchronous PPP data n=7—Displays B-channel data in raw hexadecimal form n=8—Displays Layer 1 data using I.430 decoder EMBEDDED PROTOCOL ANALYZER (EPA) INITIALIZATION COMMANDS n=98—Disables saving to the decode buffer n=99—Initializes the decode buffer and begins saving all data specified by S102
Default:	n/a
Description:	The Embedded Protocol Analyzer (EPA) records and analyzes various protocols on the B-channel, D-channel, and DTE-DCE interface. The EPA is useful as a diagnostic tool, in that essential data messages are displayed. This offers the ability to observe interactive operations of the TA, Central Office, and remote

communications equipment. All EPA information stored in the decode buffer contains a timestamp. The timestamp has the form [DD, HH:MM:SS:mmm] where DD is the day, HH is the hour, MM is the minute, SS is the second, and mmm is the millisecond at which the information was recorded. This time is the time since the TA was powered on or reset. For example, when the TA is powered on, the first immediate timestamp would be [00, 00:00:00:000]. Three minutes after power-on the timestamp would be [00, 00:03:00:000]. Timestamping is useful for aiding in cross-referencing the order of events between the logging buffer and decode buffer. It is also useful for determining the amount of time between events in question. Refer to S-register **S102** for details on what types of information can be stored or ignored—useful for focusing on a certain type of information.

- Command: **\*FSn**  
 Function: Reset TA  
 Unit: Decimal ASCII code  
 Values: n=0—reset and delay in boot code  
 n=1-255—reset immediately  
 Default: **\*FS0** (reset and delay in boot code)  
 Description: **\*FSn** may be used to perform a quick reset of the TA without powering it off and on. For any value of *n* other than 0, the TA will reset immediately (most commonly **\*FS1** is used).
- Command: **\*Ln**  
 Function: Fatal Error Information  
 Unit: Decimal ASCII code  
 Values: n=blank—display fatal error information  
 n=1—perform a fatal error  
 n=2—reset fatal error information  
 Default: **\*L** (display fatal error information)  
 Description: **\*L** displays the most recent fatal errors. **\*Ln** may be used to perform a pseudo fatal error or reset the fatal error information.
- Command: **>LOG**  
 Function: Display Logging Buffer Contents  
 Unit: n/a  
 Values: n/a  
 Default: n/a  
 Description: **>LOG** displays the logging buffer contents. Without the source code, some information is still useful to the user. However, when debugging problems the source code relevant to the build (version/model) of the firmware is necessary. All log\_msg() information stored in the logging buffer contains a timestamp. The timestamp has the form [DD, HH:MM:SS:mmm] where DD is the day, HH is the hour, MM is the minute, SS is the second, and mmm is the millisecond at which the information was recorded. This time is the time since the TA was powered on or reset. For example, when the TA is powered on, the first immediate timestamp would be [00, 00:00:00:000]. Three minutes after power-on the timestamp would be [00, 00:03:00:000]. Timestamping is useful for aiding in cross-referencing the order of events between the logging buffer and decode buffer. It is also useful for determining the amount of time between events in question.
- Command: **>Sn=x, >S?**  
 Function: Logging Buffer Commands and Variables  
 Unit: Decimal ASCII code  
 Values: LOGGING COMMANDS  
 n=98,x=0—Stop logging to buffer  
 n=99,x=0—Clear logging buffer  
 n=255,x=0—Disable all logging variables  
 n=255,x=1—Enable all logging variables

LOGGING VARIABLES (*n*)  
*n*=Varies, so use **>S?** to get available listing  
*x*=**0**—disable variable *n*  
*x*=**1**—enable variable *n*

Default: n/a  
Description: The Logging Buffer stores debug/trace information that may be relevant to capturing a bug or troubleshooting interoperability problems. The logging variables correspond to logging variables in the source code and as such the logging buffer contents require the source code when tracing events or problems.

Command: **>TIME**  
Function: Display Current Timestamp  
Unit: n/a  
Values: n/a  
Default: n/a  
Description: **>TIME** displays the current timestamp which is the time since the TA was powered on or reset. The timestamp has the form [DD, HH:MM:SS:mmm] where DD is the day, HH is the hour, MM is the minute, SS is the second, and mmm is the number of milliseconds. The maximum value of the timestamp is [49, 17:02:47.295] which is 49 days, 17 hours, 2 minutes, 47 seconds, and 295 milliseconds. When the maximum timestamp value is reached, the timestamp restarts at [00, 00:00:00.000].

Command: **\*V**  
Function: Various State Information  
Unit: n/a  
Values: n/a  
Default: n/a  
Description: **\*V** displays analog port state information, digital port state information, NLS state information, LAP state information, and I.430 state information.

#### D.4.3 Debugging/Logging/Troubleshooting S-Registers

The S-registers in this section can be used in attempting to troubleshoot, debug, or even correct a current problem. Some S-registers modify functionality of various features. Some S-registers modify the functionality of the debugging/logging/troubleshooting commands described in section D.4.2.

#### D-5. Debugging/Logging/Troubleshooting S-Register Summary

S-register	Function
S92	Channel ID Information Element Octet 3 Settings
S93	Blacklisting
S94	Minimum Buffer Space After Trigger
S95	Logging Buffer Functionality
S96	Decode (EPA) Buffer Functionality
S98	ISDN_MSG Size
S99	Startup Options
S100	Flow Control High Threshold
S101	Flow Control Low Threshold
S102	Data to Save for Decoding
S103	Real-Time Decoding Display
S104	Real-Time Decoding
S105	Real-Time Logging



S-Register:	<b>S92</b>
Usage:	S92=n; S92?; S92.b=n; S92.? b=bit number, n=value
Function:	Channel ID Information Element Octet 3 Settings
Unit:	Decimal ASCII code
Range:	bit 6—Interface ID present bit 5—Interface Type bit 4—0 spare bit 3—Preferred/Exclusive 0 = Preferred 1 = Exclusive bit 2—D-channel Indicator bit 1—Info. Channel Selection bit 0—Info. Channel Selection 00 = No Channel 01 = B1 Channel 10 = B2 Channel 11 = Any Channel
Default:	<b>3</b> (00000011 binary) Preferred, Any Channel
Description:	<b>S92</b> allows octet 3 of the Channel Identification Information Element to be modified, but currently only bits 3, 1, and 0 can be modified. Bit 3 controls the Preferred/Exclusive setting. Bits 1 and 0 control the Information Channel Selection. To force a call on B2, set bit 3 to 1 ( <b>S92.3=1</b> ), set bit 1 to 1 ( <b>S92.1=1</b> ), and set bit 0 to 0 ( <b>S92.0=0</b> )—or simply set <b>S92=10</b> which does the same as setting each bit individually. By default, the Channel ID is preferred/any channel.
S-Register:	<b>S93</b>
Usage:	S93=n; S93?
Function:	Blacklisting
Unit:	Decimal ASCII code
Range:	n=0 (Disable), n=1 (Enable)
Default:	1 (Enabled)
Description:	<b>S93</b> determines whether blacklisting is enabled or disabled. Blacklisting currently only affects the NET3 and INS64 switch types. For Australia (NET3) and Japan (INS64), blacklisting is required. For Europe (NET3), blacklisting may be disabled if it becomes a problem by setting <b>S93=0</b> . By default, blacklisting is enabled for NET 3 and INS64, however, it should be rare that blacklisting occurs.
S-Register:	<b>S94</b>
Usage:	S94=n; S94?
Function:	Minimum Buffer Space After Trigger
Unit:	10 bytes
Range:	n= <b>0-255</b> (0-2550 bytes)
Default:	<b>10</b> (100 bytes)
Description:	When <b>S95</b> and/or <b>S96</b> are set to continuously store information until a specific event (or trigger) occurs, then once that trigger occurs a minimum number of bytes will be freed (if needed) in the respective buffer. <b>S94</b> sets the minimum number of bytes requested to be freed in the respective buffer once a trigger has occurred. By default a minimum of 100 bytes are freed in the respective buffer.
S-Register:	<b>S95</b>
Usage:	S95=n; S95?
Function:	Logging Buffer Functionality
Unit:	Decimal ASCII code
Range:	n= <b>0</b> —Stop when full, n= <b>1</b> —Wrap continuously, *** The Following Are Triggers ***

- n=2—Line Not Ready
- Default: **0** (Stop when full)
- Description: The logging buffer has the capability “Stop when full,” “Wrap continuously,” or continuously store information until a specific event (or trigger) occurs. “Stop when full” causes the TA to stop accepting new information when the buffer is full. “Wrap continuously” will always accept new information into the buffer, but the oldest information will be thrown away to make room for the new information. Specifying a trigger will set the TA to wrap continuously, however once the specified event (or trigger) occurs, then the TA will free a minimum number of bytes specified by **S94** and then stop when the buffer is full. **ATS95?<CR>** will give further information about the logging buffer such as the number of bytes in the buffer, the type of trigger in use, and whether the trigger has occurred. **AT>LOG<CR>** retrieves the logging information. **AT>S99=0<CR>** clears the buffer. By default the logging buffer will stop accepting information when the buffer is full.
- S-Register: **S96**
- Usage: S96=n; S96?
- Function: Decode (EPA) Buffer Functionality
- Unit: Decimal ASCII code
- Range: n=0—Stop when full,  
n=1—Wrap continuously,  
\*\*\* The Following Are Triggers \*\*\*  
n=2—Line Not Ready
- Default: **0** (Stop when full)
- Description: The decode buffer has the capability “Stop when full,” “Wrap continuously,” or continuously store information until a specific event (or trigger) occurs. “Stop when full” causes the TA to stop accepting new information when the buffer is full. “Wrap continuously” will always accept new information into the buffer, but the oldest information will be thrown away to make room for the new information. Specifying a trigger will set the TA to wrap continuously, however once the specified event (or trigger) occurs, then the TA will free a minimum number of bytes specified by **S94** and then stop when the buffer is full. **ATS96?<CR>** will give further information about the decode buffer such as the number of bytes in the buffer, the type of trigger in use, and whether the trigger has occurred. **>Dn** commands retrieve the decode information. **AT>D99<CR>** clears the buffer. By default the decode buffer will stop accepting information when the buffer is full.
- S-Register: **S98**
- Usage: S98=n; S98?
- Function: ISDN\_MSG Size
- Unit: 1 byte
- Range: n=0-255 (0-255 bytes)
- Default: **50** (50 bytes)
- Description: Sets the maximum number of bytes per packet that are stored in the decode buffer. Since the decode buffer has a limited size it is useful to “see” a broader picture rather than each packet in detail. Data packets may typically be larger than 255 bytes. By default only 50 bytes per packet are stored.
- S-Register: **S99**
- Usage: S99=n; S99?; S99.b=n; S99.?  
b=bit number, n=value
- Function: Startup Options
- Unit: Decimal ASCII code
- Range: bit 0—Initialize the Logging buffer,  
bit 1—Initialize the EPA buffer,  
bit 2—Save to Log buffer (same as **>S99=0**),  
bit 3—Save to EPA buffer (same as **>D99**),

- bit 4—Save logging (>S*n*) flags,  
bit 5—Allow `tst_CheckPoint()` calls
- Default: **7** (Init Log, Init EPA, Save to Log)
- Description: **S99** controls startup features. If buffers are set to not be initialized, then if the TA resets those buffers will not be initialized and thus the data can be retrieved (assuming that >S99=0 or >D99 were given prior to the reset or fatal error). If the TA will be reset several times, but the data should be kept after each reset, then the buffers should not be initialized (except to initially give the >S99=0 and/or >D99 command) and the save to EPA and/or save to Log bits would need to be set. The “Save logging flags” bit when set will store the >S*n* logging flag settings in the E2PROM so that on power-up those flags will be set and logging can begin immediately. When the bit is cleared, the >S*n* flags are not modified nor will the flags be changed from default when the TA powers up. `tst_CheckPoint()` helps in the debugging of an unrecoverable fatal error or power-up problem.
- S-Register: **S100**
- Usage: S100=*n*; S100?
- Function: Flow Control High Threshold
- Unit: 1 buffer
- Range: *n*=**0-255** (0-255 buffers)
- Default: varies
- Description: **S100** may be used to increase or decrease the high threshold for flow control (the point at which flow control is asserted).
- S-Register: **S101**
- Usage: S101=*n*; S101?
- Function: Flow Control Low Threshold
- Unit: 1 buffer
- Range: *n*=**0-255** (0-255 buffers)
- Default: varies
- Description: **S101** may be used to increase or decrease the low threshold for flow control (the point at which flow control is negated).
- S-Register: **S102**
- Usage: S102=*n*; S102?; S102.b=*n*; S102.?
- b=bit number, *n*=value
- Function: Data to Save for Decoding
- Unit: Decimal ASCII code
- Range: bit 0—Layer 1  
bit 1—Layer 2 (D)  
bit 2—Layer 3 (D)  
bit 3—B1  
bit 4—B2  
bit 5—Async Port 1
- Default: **127** (Layer 1, Layer 2, Layer 3, B1, B2, Async Ports 1)
- Description: **S102** allows complete control over the types of data stored in RAM for decoding at a later time and/or the types of data allowed for Real-Time Decoding. “Layer 1” consists of the I.430 state transitions and events (decoded by >D8). “Layer 2” consists of the Q.921 messages sent and received on the D-channel (decoded by >D2). “Layer 3” consists of the Q.931 messages sent and received on the D-channel (decoded by >D3, >D38, or >D39). B1 consists of digital data sent and received on B-channel 1 (decoding depends on data protocol). B2 consists of digital data sent and received on B-channel 2 (decoding depends on data protocol). Async Port 1 consists of data sent and received between port 1 of the TA and the asynchronous terminal (decoded by >D5 if PPP). **S102?** will give bit-level details of this S-register. Refer to the >D*n* command for details on decoding data stored in RAM. By default all options (bits) are enabled (set to 1).

- S-Register: **S103**  
 Usage: S103=n; S103?; S103.b=n; S103.?  
 b=bit number, n=value  
 Function: Real-Time Decoding Display  
 Unit: Decimal ASCII code  
 Range: bit 0—Layer 1  
 bit 1—Layer 2  
 bit 2—Layer 3 short  
 bit 3—Layer 3 long  
 bit 4—Raw B1  
 bit 5—Raw B2  
 bit 6—Decode B1  
 bit 7—Decode B2  
 Default: **0** (None decoded and displayed)  
 Description: **S103** selects the type(s) of data to decode in real-time. If a certain type of data is to be decoded in real-time according to **S103** and **S102** allows that data to be decoded, then that data type will not be stored in RAM for later decoding via **>Dn** commands. Data types not decoded in real-time according to **S103** yet **S102** allows the data type to be decoded will be stored in RAM for later decoding via **>Dn** commands. “Layer 1” outputs decoded I.430 state transitions and events (decoded by **>D8**). “Layer 2” outputs decoded Q.921 information sent and received on the D-channel (decoded by **>D2**). “Layer 3 short” outputs Q.931 messages sent and received on the D-channel, but only the message-type and not the Information Elements is decoded (decoded by **>D39**). “Layer 3 long” outputs decoded Q.931 messages sent and received on the D-channel (decoded by **>D3**). If both “Layer 3 short” and “Layer 3 long” are enabled, then “Layer 3 long” will override “Layer 3 short.” “Raw B1” outputs raw hexadecimal data sent and received on B-channel 1—similar to the **>D7** command. “Raw B2” outputs raw hexadecimal data sent and received on B-channel 2—similar to the **>D7** command. “Decode B1” outputs decoded data protocol information sent and received on B-channel 1 only if the data protocol is V.120 or X.75. “Decode B2” outputs decoded data protocol information sent and received on B-channel 2 only if the data protocol is V.120 or X.75. By default all options (bits) are disabled (set to 0).
- S-Register: **S104**  
 Usage: S104=n; S104?  
 Function: Real-Time Decoding  
 Unit: 10ms  
 Range: n=0 (Real-Time Decoding Disabled),  
 n=1-255 (10ms-2.55s)  
 Default: **0** (Real-Time Decoding Disabled)  
 Description: If **S104** is set to a non-zero value, then Real-Time Decoding will be enabled on the port to which it was given. For autobauding devices, the serial rate will then be fixed at the rate of the command given. The delay before displaying decoded information can be set from 10ms to 2.55 seconds. When there is a great deal of activity in the TA it is probably best to set for a higher delay, but generally **S104=1** (10ms of delay) is good at a serial rate of 115200. If there is too much activity in the data types allowed by **S102** and **S103**, then some decoded information will be thrown away until the activity allows decoding to continue. If DTR is negated (judged by the setting of **&Dn**), then decoded information will also be thrown away. The number of decoded information buffers that are thrown away are kept track of by wNumTracesDenied, which can be viewed by giving the command **ATS96?<CR>**. wNumTracesDenied is reset to 0 upon power-up and whenever **S104** is set to a non-zero value. If Real-Time Logging is enabled and the ports to which Real-Time Logging and Real-Time Decoding are enabled match (I.E. giving both commands **S104=1** and **S105=1** to port 1), then the real-time logging information and the real-time decoding information will be merged in sequence according to the time-stamp. By default Real-Time Decoding is disabled.

**S-Register:** **S105**  
**Usage:** S105=n; S105?  
**Function:** Real-Time Logging  
**Unit:** 10ms  
**Range:** n=0 (Real-Time Logging Disabled),  
n=1-255 (10ms-2.55s)  
**Default:** 0 (Real-Time Logging Disabled)  
**Description:** If **S105** is set to a non-zero value, then Real-Time Logging will be enabled on the port to which it was given. For autobauding devices, the serial rate will then be fixed at the rate of the command given. The delay before displaying log information can be set from 10ms to 2.55 seconds. When there is a great deal of activity in the TA it is probably best to set for a higher delay, but generally **S105=1** (10ms of delay) is good at a serial rate of 115200. If there is too much activity, then some log information will be thrown away until the activity allows logging to continue. If DTR is negated (judged by the setting of **&Dn**), then log information will also be thrown away. The number of log information buffers that are thrown away are kept track of by **wNumTracesDenied**, which can be viewed by giving the command **ATS95?<CR>**. **wNumTracesDenied** is reset to 0 upon power-up and whenever **S105** is set to a non-zero value. If Real-Time Decoding is enabled and the ports to which Real-Time Logging and Real-Time Decoding are enabled match (I.E. giving both commands **S104=1** and **S105=1** to port 1), then the real-time logging information and the real-time decoding information will be merged in sequence according to the time-stamp. By default Real-Time Logging is disabled.

## D.5 Test Commands

**Table D-6. Test Command Summary**

AT Command	Function
>LBn	Loop-back Control
Unm	B-channel Loop-back

**Command:** **>LBn**  
**Function:** Loop-back Control  
**Unit:** Decimal ASCII code  
**Values:** n=0—no loop-back,  
n=1—loop-back B-channel data, but do not pass data to DTE,  
n=2—loop-back B-channel data, but also pass data to DTE,  
n=16—loop-back DTE data, but do not pass to B-channel,  
n=32—loop-back DTE data and pass to B-channel if available  
**Default:** **>LB0** (no loop-back)  
**Description:** **>LBn** is a test command that can aid in testing various data protocols, performance, and integrity of the data by using an external tester to send data via the B-channel or DTE, loop the data back, and the external tester can keep track of the integrity and performance of various data protocols. When performing B-channel loop-back (n=1, n=2), then DTE loop-back (n=16, n=32) is not available. When performing DTE loop-back (n=16, n=32), then B-channel loop-back (n=1, n=2) is not available. To break out of DTE loop-back, use the escape sequence followed by **AT<CR>** (such as **+++AT<CR>**).

Command: **Unm**  
 Function: B-channel Loop-back  
 Unit: Decimal ASCII code  
 Values: n=1—Loop-back on B1 only,  
 n=2—Loop-back on B2 only,  
 n=3—loop-back on both B-channels  
 m=0—disable loop-back,  
 m=1—enable loop-back  
 Default: **U30** (no loop-back)  
 Description: **>LBn** is a test command that is used mainly for conformance testing. **Unm** puts specific B-channels in loop-back within the ISDN transceiver as opposed to the processor dealing with loop-back as is the case for the **>LBn** command. For example, **ATU31<CR>** sets the ISDN transceiver to loop back both B-channel 1 and B-channel 2 data. **ATU30<CR>** disables loop-back on both B-channels.

## D.6 Factory Profiles

### Profile 0 (&F0) Modem-Like Asynchronous Operation

AT Command	Description
&C1	DCD functions normally
\$D0	Disable persistent DTR dialing
&D1	Hang up when DTR drops
E1	Enable command mode echo
&E4	Enable hardware flow control
&E6	Discard XON/XOFF characters
&E13	Enable pacing
#X0	Disable Sending Multiple Xoff Characters
%E1	Enable +++ escape method
%E4	No OK response to +++ or <BREAK> escape
&R1	CTS always high
&RF1	CTS is independent of RTS
S0=1	Answer after 1 ring
S2=43	Set escape character to + (ASCII 43)
S3=13	Set carriage return character to CR (ASCII 13)
S4=10	Set line feed character to LF (ASCII 10)
S5=8	Set backspace character to BS (ASCII 8)
S7=45	Wait 45 seconds for connection before aborting
S10=20	Set DCD drop time to 700 ms
S25=5	Set DTR detect time to 500 ms
S32=20	Set escape sequence guard time to 2 seconds
S34=2	Set maximum escape sequence character length
S50=0	Caller Line ID disabled
S52=1	Auto-Protocol Detection Enabled
S53=2048	Maximum X.75 Buffer Size (2048 bytes)
&S1	DSR follows DCD
V1	Select verbose messages
!Z=x	The data protocol is not modified

### Profile 1 (&F1)—V.120 Asynchronous Operation

AT Command	Description
&C1	DCD functions normally
\$D0	Disable persistent DTR dialing
&D1	Hang up when DTR drops
E1	Enable command mode echo
&E4	Enable hardware flow control
&E6	Discard XON/XOFF characters
&E13	Enable pacing
#X0	Disable Sending Multiple Xoff Characters

%E1	Enable +++ escape method
%E4	No OK response to +++ or <BREAK> escape
&R1	CTS always high
&RF1	CTS is independent of RTS
S0=1	Answer after 1 ring
S2=43	Set escape character to + (ASCII 43)
S3=13	Set carriage return character to CR (ASCII 13)
S4=10	Set line feed character to LF (ASCII 10)
S5=8	Set backspace character to BS (ASCII 8)
S7=45	Wait 45 seconds for connection before aborting
S10=20	Set DCD drop time to 700 ms
S25=5	Set DTR detect time to 500 ms
S32=20	Set escape sequence guard time to 2 seconds
S34=2	Set maximum escape sequence character length
S50=0	Caller Line ID disabled
S52=1	Auto-Protocol Detection Enabled
S53=2048	Maximum X.75 Buffer Size (2048 bytes)
S75=0	Maximum V.110 Buffer Size (256 bytes)
&S1	DSR follows DCD
V1	Select verbose messages
!Z=5	Enable V.120 data protocol

### Profile 2 (&F2)—X.75 Asynchronous Operation

AT Command	Description
&C1	DCD functions normally
\$D0	Disable persistent DTR dialing
&D1	Hang up when DTR drops
E1	Enable command mode echo
&E4	Enable hardware flow control
&E6	Discard XON/XOFF characters
&E13	Enable pacing
#X0	Disable Sending Multiple Xoff Characters
%E1	Enable +++ escape method
%E4	No OK response to +++ or <BREAK> escape
&R1	CTS always high
&RF1	CTS is independent of RTS
S0=1	Answer after 1 ring
S2=43	Set escape character to + (ASCII 43)
S3=13	Set carriage return character to CR (ASCII 13)
S4=10	Set line feed character to LF (ASCII 10)
S5=8	Set backspace character to BS (ASCII 8)
S7=45	Wait 45 seconds for connection before aborting
S10=20	Set DCD drop time to 700 ms
S25=5	Set DTR detect time to 500 ms
S32=20	Set escape sequence guard time to 2 seconds
S34=2	Set maximum escape sequence character length
S50=0	Caller Line ID disabled
S52=1	Auto-Protocol Detection Enabled
S53=2048	Maximum X.75 Buffer Size (2048 bytes)
&S1	DSR follows DCD
V1	Select verbose messages
!Z=12	Enable X.75 data protocol

**Profile 3 (&F3)—PPP Asynchronous Operation**

AT Command	Description
&C1	DCD functions normally
\$D0	Disable persistent DTR dialing
&D1	Hang up when DTR drops
E1	Enable command mode echo
&E4	Enable hardware flow control
&E6	Discard XON/XOFF characters
&E13	Enable pacing
#X0	Disable Sending Multiple Xoff Characters
%E1	Enable +++ escape method
%E4	No OK response to +++ or <BREAK> escape
&R1	CTS always high
&RF1	CTS is independent of RTS
S0=1	Answer after 1 ring
S2=43	Set escape character to + (ASCII 43)
S3=13	Set carriage return character to CR (ASCII 13)
S4=10	Set line feed character to LF (ASCII 10)
S5=8	Set backspace character to BS (ASCII 8)
S7=45	Wait 45 seconds for connection before aborting
S10=20	Set DCD drop time to 700 ms
S25=5	Set DTR detect time to 500 ms
S32=20	Set escape sequence guard time to 2 seconds
S34=2	Set maximum escape sequence character length
S50=0	Caller Line ID disabled
S52=1	Auto-Protocol Detection Enabled
S53=2048	Maximum X.75 Buffer Size (2048 bytes)
&S1	DSR follows DCD
V1	Select verbose messages
!Z=9	Enable PPP data protocol



**Profile 4 (&F4)—HDLC Asynchronous Operation**

AT Command	Description
&C1	DCD functions normally
\$D0	Disable persistent DTR dialing
&D1	Hang up when DTR drops
E1	Enable command mode echo
&E4	Enable hardware flow control
&E6	Discard XON/XOFF characters
&E13	Enable pacing
#X0	Disable Sending Multiple Xoff Characters
%E1	Enable +++ escape method
%E4	No OK response to +++ or <BREAK> escape
&R1	CTS always high
&RF1	CTS is independent of RTS
S0=1	Answer after 1 ring
S2=43	Set escape character to + (ASCII 43)
S3=13	Set carriage return character to CR (ASCII 13)
S4=10	Set line feed character to LF (ASCII 10)
S5=8	Set backspace character to BS (ASCII 8)
S7=45	Wait 45 seconds for connection before aborting
S10=20	Set DCD drop time to 700 ms
S25=5	Set DTR detect time to 500 ms
S32=20	Set escape sequence guard time to 2 seconds
S34=2	Set maximum escape sequence character length
S50=0	Caller Line ID disabled
S52=0	Auto-Protocol Detection Disabled
S53=2048	Maximum X.75 Buffer Size (2048 bytes)
&S1	DSR follows DCD
V1	Select verbose messages
!Z=7	Enable HDLC data protocol

## Appendix E - TCP/IP

### TCP/IP

TCP/IP (Transmission Control Protocol/Internet Protocol) is a protocol suite and related applications developed for the U.S. Department of Defense in the 1970s and 1980s specifically to permit different types of computers to communicate and exchange information with one another. TCP/IP is currently mandated as an official U.S. Department of Defense protocol and is also widely used in the UNIX community.

Before you install TCP/IP on your network, you need to establish your Internet addressing strategy. First, choose a domain name for your company. A domain name is the unique Internet name, usually the name of your business, that identifies your company. For example, Multi-Tech's domain name is `multitech.com` (where `.com` indicates this is a commercial organization; `.edu` denotes educational organizations, `.gov` denotes government organizations). Next, determine how many IP addresses you'll need. This depends on how many individual network segments you have, and how many systems on each segment need to be connected to the Internet. You'll need an IP address for each network interface on each computer and hardware device.

IP addresses are 32 bits long and come in two types: network and host. Network addresses come in five classes: A, B, C, D, and E. Each class of network address is allocated a certain number of host addresses. For example, a class B network can have a maximum of 65,534 hosts, while a class C network can have only 254. The class A and B addresses have been exhausted, and the class D and E addresses are reserved for special use. Consequently, companies now seeking an Internet connection are limited to class C addresses.

Early IP implementations ran on hosts commonly interconnected by Ethernet local area networks (LAN). Every transmission on the LAN contains the local network, or medium access control (MAC), address of the source and destination nodes. The MAC address is 48-bits in length and is non-hierarchical; MAC addresses are never the same as IP addresses.

When a host needs to send a datagram to another host on the same network, the sending application must know both the IP and MAC addresses of the intended receiver. Unfortunately, the IP process may not know the MAC address of the receiver. The Address Resolution Protocol (ARP), described in RFC 826 (located at <ftp://ds.internic.net/rfc/rfc826.txt>) provides a mechanism for a host to determine a receiver's MAC address from the IP address. In the process, the host sends an ARP packet in a frame containing the MAC broadcast address; and then the ARP request advertises the destination IP address and asks for the associated MAC address. The station on the LAN that recognizes its own IP address will send an ARP response with its own MAC address. An ARP message is carried directly in an IP datagram.

Other address resolution procedures have also been defined, including those which allow a diskless processor to determine its IP address from its MAC address (Reverse ARP, or RARP), provides a mapping between an IP address and a frame relay virtual circuit identifier (Inverse ARP, or InARP), and provides a mapping between an IP address and ATM virtual path/channel identifiers (ATMARP).

The TCP/IP protocol suite comprises two protocols that correspond roughly to the OSI Transport and Session Layers; these protocols are called the Transmission Control Protocol and the User Datagram Protocol (UDP). Individual applications are referred to by a port identifier in TCP/UDP messages. The port identifier and IP address together form a "socket". Well-known port numbers on the server side of a connection include 20 (FTP data transfer), 21 (FTP control), 23 (Telnet), 25 (SMTP), 43 (whois), 70 (Gopher), 79 (finger), and 80 (HTTP).

TCP, described in RFC 793 (<ftp://ds.internic.net/rfc/rfc793.txt>) provides a virtual circuit (connection-oriented) communication service across the network. TCP includes rules for formatting messages, establishing and terminating virtual circuits, sequencing, flow control, and error correction. Most of the applications in the TCP/IP suite operate over the "reliable" transport service provided by TCP.

UDP, described in RFC 768 (<ftp://ds.internic.net/rfc/rfc768.txt>) provides an end-to-end datagram (connectionless) service. Some applications, such as those that involve a simple query and

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response, are better suited to the datagram service of UDP because there is no time lost to virtual circuit establishment and termination. UDP's primary function is to add a port number to the IP address to provide a socket for the application.

The Application Layer protocols are examples of common TCP/IP applications and utilities, which include:

- Telnet (Telecommunication Network): a virtual terminal protocol allowing a user logged on to one TCP/IP host to access other hosts on the network, described in RFC 854 (<ftp://ds.internic.net/rfc/rfc854.txt>).
- FTP: the File Transfer Protocol allows a user to transfer files between local and remote host computers per IETF RFC 959 (<ftp://ds.internic.net/rfc/rfc959.txt>).
- Archie: a utility that allows a user to search all registered anonymous FTP sites for files on a specified topic.
- Gopher: a tool that allows users to search through data repositories using a menu-driven, hierarchical interface, with links to other sites, per RFC 1436 (<ftp://ds.internic.net/rfc/rfc1436.txt>).
- SMTP: the Simple Mail Transfer Protocol is the standard protocol for the exchange of electronic mail over the Internet, per IETF RFC 821 (<ftp://ds.internic.net/rfc/rfc821.txt>).
- HTTP: the Hypertext Transfer Protocol is the basis for exchange of information over the World Wide Web (WWW). Various versions of HTTP are in use over the Internet, with HTTP version 1.0 (per RFC 1945) (<ftp://ds.internic.net/rfc/rfc1945.txt>) being the most current.
- HTML: WWW pages are written in the Hypertext Markup Language (HTML), an ASCII-based, platform-independent formatting language, per IETF RFC 1866 (<ftp://ds.internic.net/rfc/rfc1866.txt>).
- Finger: used to determine the status of other hosts and/or users, per IETF RFC 1288 (<ftp://ds.internic.net/rfc/rfc1288.txt>).
- POP: the Post Office Protocol defines a simple interface between a user's mail reader software and an electronic mail server; the current version is POP3, described in IETF RFC 1460 (<ftp://ds.internic.net/rfc/rfc1460.txt>).
- DNS: the Domain Name System defines the structure of Internet names and their association with IP addresses, as well as the association of mail, name, and other servers with domains.
- SNMP: the Simple Network Management Protocol defines procedures and management information databases for managing TCP/IP-based network devices. SNMP, defined by RFC 1157 (<ftp://ds.internic.net/rfc/rfc1157.txt>) is widely deployed in local and wide area network. SNMP Version 2 (SNMPv2), per RFC 1441 (<ftp://ds.internic.net/rfc/rfc1441.txt>) adds security mechanisms that are missing in SNMP, but is also more complex.
- Ping: a utility that allows a user at one system to determine the status of other hosts and the latency in getting a message to that host. Ping uses ICMP Echo messages.
- Whois/NICNAME: Utilities that search databases for information about Internet domain and domain contact information, per RFC 954 (<ftp://ds.internic.net/rfc/rfc954.txt>).
- Traceroute: a tool that displays the route that packets will take when traveling to a remote host.

## Internet Protocol (IP)

IP is the Internet standard protocol that tracks Internetwork node addresses, routes outgoing messages and recognizes incoming messages, allowing a message to cross multiple networks on the way to its final destination. The IPv6 Control Protocol (IPV6CP) is responsible for configuring, enabling, and disabling the IPv6 protocol modules on both ends of the point-to-point link. IPV6CP uses the same packet exchange mechanism as the Link Control Protocol (LCP). IPV6CP packets are not exchanged until PPP has reached the Network-Layer Protocol phase. IPV6CP packets received before this phase is reached are silently discarded. (See also TCP/IP.)

Before you install TCP/IP on your network, you need to establish your Internet addressing strategy. You first choose a domain name for your company. A domain name is the unique Internet name, usually the name of your business, that identifies your company. For example, Multi-Tech's domain name is multitech.com (where .com indicates this is a commercial organization; .edu denotes educational organizations, .gov denotes government organizations, etc.). Next, you determine how many IP addresses you'll need. This depends on how many individual network segments you have, and how many systems on each segment need to be connected to the Internet. You need an IP address for each network interface on each computer and hardware device.

IP addresses are 32 bits long and come in two types: network and host. Network addresses come in five classes: A, B, C, D, and E. Each class of network address is allocated a certain number of host addresses. For example, a class B network can have a maximum of 65,534 hosts, while a class C network can have only 254. The class A and B addresses have been exhausted, and the class D and E addresses are reserved for special use. Consequently, companies now seeking an Internet connection are limited to class C addresses. The current demand for Internet connections will exhaust the current stock of 32-bit IP addresses. In response, Internet architects have proposed the next generation of IP addresses, IPng (IP Next Generation). It will feature 16-byte (128-bit) addressing, surpassing the capacities of 32-bit IP. Still in its design phase, IPng (also known as IPv6) is not expected to be widely deployed before the end of this century.

An IP address can serve only a single physical network. Therefore, if your organization has multiple physical networks, you must make them appear as one to external users. This is done via "subnetting", a complex procedure best left to ISPs and others experienced in IP addressing. Since IP addresses and domain names have no inherent connection, they are mapped together in databases stored on Domain Name Servers (DNS). If you decide to let an Internet Service Provider (ISP) administer your DNS server, the ISP can assist you with the domain name and IP address assignment necessary to configure your company's site-specific system information. Domain names and IP addresses are granted by the InterNIC. To check the availability of a specific name or to obtain more information, call the InterNIC at (703)742-4777.

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## Appendix F - Modem AT Commands

ISHP modems are controlled by instructions called *AT commands*, so called because the *attention characters*, *AT*, precede each command or sequence of commands (known as a *command string*). You can send commands to the modem from your keyboard while in terminal mode, or you can use communications software to issue these commands automatically.

The modem is in command mode when it is not dialing or online. When it is in command mode, you have access to a complete communications system that allows you to use several features, including the basic AT command set described in this chapter. Using the basic AT command set, you can enter phone numbers for automatic dialing, configure modem options, and monitor telephone activity. In addition, you can command your modem to perform advanced features such as error correction, data compression, speed conversion, and more.

This chapter describes the modem's operational modes and shows you how to use each modem AT commands. These commands and responses are compatible with all systems and with all data communications software using the AT command set.

### Modes of Operation

The modem operates in two basic functional modes: *command mode* and *online mode*. (There is also an in-between state, *wait-for-carrier*, in which the modem is out of command mode but not yet online.) When you turn on the modem, it is in command mode and is ready to accept and respond to commands from your keyboard or software.

The modem enters online mode after it dials, connects with another modem, and detects a valid carrier signal. If it does not detect a carrier signal within the time frame controlled by the S-register **S7**, the modem abandons the call and reenters command mode.

You can make the modem enter online mode without dialing by entering **AT** and then **D** (dial) or **A** (force answer mode). The modem exits online mode if the carrier signal is lost or intentionally dropped. When this happens, the modem hangs up and reenters command mode. By sending certain *escape* characters to the modem while online, you can make it enter command mode without losing the carrier signal. While waiting to establish the carrier, you can type any character from the keyboard to make the modem to go back to the command mode.

### Command Structure

You can control a wide variety of modem operations and options when the modem is in command mode. AT commands tell the modem to dial a number, to answer a call, to operate at a certain speed, to use a certain compression technique, and many other functions. AT commands consist of one or two letters, which may be preceded by an ampersand (**&**), a percent character (**%**), or a slash (**/**). The **Q** command, for example, determines whether the modem returns result codes, while the **&Q** command selects the asynchronous communications mode.

A parameter after a command (0, 1, 2, etc.) tells the modem which option to use. If you do not specify a parameter, the modem assumes the 0 (zero) option. **E**, for example, is the same as **E0**. You can issue several commands on a single line (a command string) as long as the line does not exceed 40 characters.

**Note:** Each character in a command counts toward the 40 character command line maximum. Example: **Q1** is a single command, but it counts as two characters in the command line.

Each command has a valid range of parameters. For example, **&S** can have only 0 or 1 as a parameter. Valid commands always generate an OK result code, and a few generate an additional response such as a list of parameters. An invalid command such as **&S3**, which has a parameter outside the valid range, generates an ERROR result code. Most commands have a default parameter that is enabled when the modem is turned on or reset with the **ATZ** or **AT&F** command. Factory defaults are stored in read-only memory (ROM) and cannot be changed. User-defined defaults can be stored in nonvolatile random-access memory (NVRAM) and can be changed or deleted at will.

## Command Editing

Always begin a command with the letters *AT*. Enter the entire command string in upper or lower case, but do not mix cases within the command string. The AT command is not executed until you press ENTER. Use the BACKSPACE key to erase the previous command character. It will not erase the AT characters once they are typed. If your keyboard has no BACKSPACE key, use CTRL+H. (You can change the character recognized by the modem as BACKSPACE to any other ASCII character by changing register **S5**.)

Press CTRL+X to cancel an entire command that has been typed but not yet executed. This also clears the command buffer. The effect is the same as backspacing the command, only quicker.

The modem stores characters entered in a command in its command buffer until they are executed by pressing ENTER. The command buffer's capacity is 40 characters. The attention characters (AT) do not count toward the 40-character command line maximum. You may use spaces for increased readability when typing a command. Spaces are not stored in the command buffer, and they do not count towards the 40-character command line maximum. Special characters, such as hyphens and parentheses, are not allowed.

If you exceed the 40-character limit or type invalid characters, the command buffer is automatically erased and an ERROR message appears. Retype the command within the 40-character limit, using only the allowed characters.

The commands in this chapter are organized by function. Abbreviated commands are listed on the next page by function along with a short description and page numbers that refer to a more detailed description, immediately following this list.

Topic	Command	Description
Dialing Action, p. 127	<b>D</b>	Dial
	<b>H</b>	On-hook/off-hook
<b>Dial Modifiers</b> , p. 128	<b>L, P, T, W</b>	Command accepted, but has no function
	<b>,</b>	Command accepted, but has no function
	<b>;</b>	Command accepted, but has no function
	<b>! \$ @ ^</b>	Command accepted, but has no function
<b>Phone Number Memory</b> , p. 128	<b>&amp;Z</b>	Store a phone number
	<b>DS</b>	Dial a stored number
<b>Configuration Storage &amp; Recall</b> , p. 129	<b>&amp;W</b>	Store configuration
	<b>&amp;F</b>	Load factory default configuration
	<b>Z</b>	Reset modem
	<b>&amp;Y</b>	Select stored configuration on power-up
	<b>E</b>	Echo command mode characters
<b>Modem Responses (Result Codes)</b> , p. 130	<b>Q</b>	Result codes: enable/disable
	<b>V</b>	Result codes: verbose/terse
	<b>W</b>	Protocol result code
	<b>X</b>	Result codes and call progress
	<b>&amp;Q</b>	Select asynchronous communications mode
<b>Online Connection</b> , p. 133	<b>B</b>	Answer tone
	<b>C</b>	Carrier control

	<b>F</b>	Echo online data characters
	<b>&amp;G</b>	Guard tones
	<b>-C</b>	Data calling tone
	<b>N</b>	Modulation handshake
	<b>\T</b>	Disable inactivity timer
	<b>Y</b>	Long space disconnect
<b>RS-232 Interface Controls</b> , p. 135	<b>&amp;C</b>	Carrier Detect control
	<b>&amp;D</b>	Data Terminal Ready control
	<b>&amp;S</b>	Data Set Ready control
<b>Error Correction &amp; Data Compression</b> , p. 136	<b>\N0 or &amp;Q6</b>	Non-error correction mode
	<b>\N3</b>	Auto-reliable mode
	<b>\N2</b>	Reliable mode
	<b>%C0</b>	Data compression disabled
	<b>%C1</b>	Data compression enabled
<b>Immediate Action</b> , p. 138	<b>A/</b>	Repeat last command
	<b>I</b>	Information request
	<b>&amp;B</b>	V.32 auto retrain
	<b>&amp;V</b>	View current configuration
<b>Flow Control</b> , p. 139	<b>&amp;M0</b>	Asynchronous mode
	<b>&amp;K0 or \Q0</b>	Flow control disabled
	<b>&amp;K3 or \Q3</b>	Hardware flow control
	<b>&amp;K4 or \Q1</b>	XON/XOFF flow control
	<b>\X0</b>	XON/XOFF no pass-through
	<b>&amp;J</b>	Auxiliary relay control
	<b>\J</b>	Enable data buffer control
	<b>\G</b>	Modem port flow control
	<b>\K</b>	Set break control
<b>Escape Sequences</b> , p. 141	<b>+++AT&lt;cr&gt;</b>	Default in-band escape sequence
	<b>A</b>	Force answer mode
	<b>O</b>	Go back online

## Dialing Commands

Use dialing commands to dial and hang up.

**Ds Dial**  
s = phone number  
Default: none

Causes the modem to dial the telephone number immediately following it. For example, if you type **ATD5551212<cr>**, the modem dials the number 555-1212.

**Hn On-Hook/Off-Hook**  
n = 0 or 1  
Default: 0

Makes the modem hang up (go on-hook) or simulate the action of picking up a telephone handset (go off-hook).

**H0** (or **H**) hangs up the modem  
**H1** brings the line off-hook, just as if you had picked up the telephone handset.

It is not necessary to use the **H1** command to bring the line off-hook when using the **D** command. The modem automatically goes off-hook when you press ENTER at the end of the dial command.

## Dial Modifier Commands

ISIHx modems rely on the terminal adapters on the card for dialing. For backwards compatibility, the following dial modifier commands can be included in the dial string. They are accepted by the modem, but ignore the actual function. These commands are:

**L Redial Last Number**  
**P, T Pulse or Tone Dialing**  
**W Wait for New Dial Tone**  
**, Dialing Pause**  
**; Return to Command Mode After Dialing**  
**! Flash On-Hook**  
**\$ Detect Call Card Tone**  
**@ Quiet Answer**  
**^ Disable Data Calling Tone Transmission**

## Phone Number Memory Commands

ISIHx modems can store up to 10 telephone numbers in nonvolatile memory. You can store the numbers with the **&Z** command and dial them with the **ATDS** command.

**&Zn=s Store a Phone Number**  
s = phone number  
n = 0, 1, 2 or 3  
Default: none

You can store a telephone number string in the modem's phone number memory. You can store four of these strings using the **&Zn=s** command. The memory locations are labeled *N0* through *N3*. For example, the telephone number 1-612-555-1212 is stored at memory location *N2* by typing **&Z2=16125551212** and pressing ENTER.

**DSn Dial a Stored Number**  
n = 0, 1, 2, or 3  
Default: none

You can automatically dial a telephone number that is stored in the modem's number memory by typing **ATDSn**, where *n* = 0 through 3. For example, you can dial a number stored at *N2* by typing **ATDS2** in terminal mode and pressing ENTER.



## Configuration Storage and Recall Commands

The ISiHx stores parameters in two places. It stores factory default parameters in read-only memory (ROM), and customized parameters in nonvolatile random access memory (NVRAM). You cannot change the default parameters in ROM, but you can change parameters in temporary memory and then store them in NVRAM as custom settings. You can then recall the custom settings as if they were factory default settings.

**&Wn Store Configuration**  
 $n = 0$   
 Default: **&W0**

The **&W** command stores current AT commands and S-register values in nonvolatile memory, so you won't lose your custom settings when you turn off the modem or reset it.

**&W0** (or **&W**) stores all current AT command and S-register values in nonvolatile random access memory (NVRAM) and configures the modem so it reads your custom settings in NVRAM when the modem is turned on or when it is reset with the **Z** command. The **&F** reset command continues to read the factory default settings in ROM.

**&Fn Load Default Configuration**  
 $n = 0$   
 Default: **&F0**

ISiHx modems store factory default AT command settings and S-register values in read-only memory (ROM); they store your custom AT command and S-register values in nonvolatile random access memory (NVRAM).

The **&F0** (or **&F**) command resets modem to the factory default values stored in ROM.

**Zn Reset Modem**  
 $n = 0$  or  $1$   
 Default: none

The **Z** command resets the modem to the configuration last saved by the **&W** command. The default values come from the customized configuration in NVRAM.

**Z1** is the same as **Z0**, and functions identically.

**&Yn Select Stored Configuration for Hard Reset**  
 $n = 0$   
 Default:  $0$

This command is included for compatibility with applications that issue the **&Y0** command. Modem functions are not changed.

**&Y0** selects the profile stored at location 0 on power-up.

## Modem Response (Result Code) Commands

ISiHx modems can give responses to commands. The most common is *OK*, but the modems also can alert you or your software to dial tones, busy signals, connection speeds, and whether the connection is made with error correction or compression enabled. These responses are called *result codes*; they can be terse (numbers) or verbose (text).

**En Echo Command Mode Characters**  
 $n = 0$  or  $1$   
 Default: **E1**

Normally, when you type commands on the keyboard, the modem echoes the characters back to the computer or terminal, which displays them on the monitor. Use the **E** command to turn this feature off and on.

**E0** disables the echo.

**E1** enables the echo.

**Qn**     **Result Codes Enable/Disable**  
           *n* = 0 or 1  
           Default: **Q0**

Use the **Q** command to enable or disable result codes for applications such as computer-controlled auto dialing.

**Q0** (or **Q**) enables result codes.

**Q1** disables result codes for applications such as computer-controlled auto-dialing.

**Vn**     **Result Codes (Verbose/Terse)**  
           *n* = 0 or 1  
           Default: **V1**

The **V** command controls whether the modem's result codes display as text (*verbose*) or numeric (*terse*) messages. For example, if no carrier signal is detected after dialing, the result can display either as **NO CARRIER** or as the number **3**.

**V0** (or **V**) displays the modem's result codes as a number.

**V1** displays result codes as text.

**V2**, an additional command given anytime after **ATV1** is entered, displays the connect message of both the local modem and the remote modem.

**Xn**     **Result Codes and Call Progress Selection**  
           *n* = 0, 1, 2, 3, 4, 5, 6, or 7  
           Default: **X4**

Selects which result codes the modem provides in command mode and determines whether the modem uses *smart dialing* or *blind dialing*. When it smart dials, the modem listens for dial tones and busy signals and responds to them. When it blind dials, the modem ignores the signals and relies on timing instead.

**X0** causes the modem to blind dial. Instead of looking for a dial tone, it pauses for the time set in register **S6** and then dials regardless. Once a connection is made, it sends the basic code **CONNECT** to the terminal. It ignores any busy signals.

**X1** causes the modem to blind dial. In addition to the basic **CONNECT** code, it provides extended codes consisting of the word **CONNECT** and the speed of the connection (**CONNECT 14400** or **CONNECT 28800**, for example). In this mode, the modem does not recognize or respond to dial tones or busy signals.

**X2** causes the modem to wait for a dial tone before dialing. If it does not detect a dial tone within the time set by **S6**, the modem sends a **NO DIALTONE** result code to the terminal. In this mode, the modem provides extended result codes but does not respond to busy signals.

**X3** causes the modem to blind dial and to look for a busy signal. If it detects one, it sends a **BUSY** result code to the terminal. In this mode, the modem provides extended result codes, but it does not respond to dial tones.

**X4** causes the modem to look for a dial tone and a busy signal and respond with **NO DIALTONE** or **BUSY**, as appropriate. It also provides extended result codes. It is the most useful setting for most data communication programs and is the default setting.

**X5** causes the modem to look for a dial tone and a busy signal and respond with **NO DIALTONE** or **BUSY**, as appropriate. It also provides extended result codes. It is the most useful setting for most data communication programs and is the default setting.

**X6** causes the modem to look for a dial tone and a busy signal and respond with **NO DIALTONE** or **BUSY**, as appropriate. It also provides extended result codes. It is the most useful setting for most data communication programs and is the default setting.

**X7** causes the modem to wait for a dial tone before dialing. If it doesn't detect a dial tone within the time set by **S6**, the modem sends only the basic result code to the terminal (ERROR, NO CARRIER, or CONNECT, for example). In this mode, the modem does not respond to busy signals.

**&Qn Asynchronous Communications Mode**

$n = 0, 5, \text{ or } 6$

Default: **&Q5**

Allows you to select the type of asynchronous communications mode for your modem.

**Note:** These commands are the same as several of the **\Nn** commands, described later in this chapter.

**&Q0** selects asynchronous mode with data buffering. This is the same as **\N0**, nonerror correction mode with data buffering.

**&Q5** selects error control with data buffering. This is the same as **\N3**, V.42/MNP auto-reliable mode.

**&Q6** selects asynchronous mode with data buffering. This is the same as **\N0**, non-error correction mode with data buffering.

## Online Connection Commands

The following commands control the conditions of the online connection.

**Bn Answer Tone**

$n = 0, 1, 2, 3, 15, \text{ or } 16$

Default: **B1** and **B16**

Selects the frequency the modem uses for its answer tone. (The answer tone is the tone transmitted by the receiving modem to the calling modem, thus initiating the *handshake* between the two modems.) At higher speeds (2400 bps and above) there is no conflict because all protocols use the Bell frequency of 2225 Hz. Lower speeds require different frequencies.

**B0** selects ITU-T V.22 mode when the modem is at 1200 bps.

**B1** selects Bell 212A when the modem is at 1200 bps. This is a default.

**B15** selects V.21 when the modem is at 300 bps.

**B16** selects Bell 103J when the modem is at 300 bps. This is a default.

**Cn Dummy Command**

**-Cn Data Calling Tone**

$n = 0 \text{ or } 1$

Default: **-C0**

The data calling tone is a tone of a certain frequency and cadence, as specified in the V.25 standards, which identifies whether it is remote data, fax, or voice. The frequency is 1300 Hz, with a cadence of .5 s on and 2 s off.

**-C0** disables the V.25 data calling tone.

**-C1** enables the V.25 data calling tone.

**F Dummy command**

**&Gn Guard Tones**

$n = 0, 1, \text{ or } 2$

Default: **&G0** (models outside U.K.) or **&G2** (U.K. models only)

Controls the presence or absence of guard tones from the transmitter when in answer mode at either 1200 or 2400 bps. Guard tones are used in Europe and other areas to allow the modem to function in the telephone systems. Guard tones are not used in the United States. U.K. models are locked at **&G2** (1800 Hz guard tone).

**&G0** disables ITU-T guard tones.

**&G1** enables ITU-T 550 Hz guard tone.

**&G2** enables ITU-T 1800 Hz guard tone.

**Nn Modulation Handshake**

*n* = 0 or 1  
 Default: **N1**

Controls whether the local modem performs a negotiated handshake with the remote modem at connection time when the communication speed of the two modems is different.

**N0** enables handshaking only at the communication standard specified by S37 and the **ATB** command.

**N1** always begins the handshake only at the communication standard specified by S37 and the **ATB** command, but allows fallback to a lower speed as the handshake proceeds. This is the default.

**\Tn Inactivity Timer**

*n* = 0  
 Default: **\T0**

The inactivity timer specifies the length of time, in minutes, that the modem waits before disconnecting when no data is sent or received. This timer is specified in register **S30**. The **\T0** command disables the inactivity timer.

**Yn Long Space Disconnect**

*n* = 0, 1  
 Default: **Y0**

When two modems are connected in reliable mode, a link disconnect request packet is sent to request a disconnect. In non-error correction mode, there is no *polite* way to request a disconnect. As a result, some *garbage* may be received when a hang-up command is issued.

**Y0** disables the modem's use of the break signal.

**Y1** enables long space disconnect.

## RS-232 Interface Commands

These commands define how the ISIHP-2S/2U modems use and respond to standard RS-232 signals.

**&Cn Carrier Detect Control**

*n* = 0 or 1  
 Default: **&C1**

Allows you to control the Carrier Detect (CD) signal on the RS-232/V.24 interface. This is a signal from the modem to your computer indicating that the carrier signal is being received from a remote modem. Normally, CD goes *high* (turns on) when the modem detects a carrier on the communications link and *drops* (turns off) when it loses the carrier. By using **&C**, you can force the signal to stay high, or to drop momentarily when the remote modem disconnects. This option is useful with some CBX phone systems and mainframe front ends, which require CD to act in this manner.)

**&C0** ignores the state of the carrier from the remote modem. CD is forced high.

**&C1** allows CD to act normally—to go high when the modem detects a carrier, and to drop when it loses the carrier.

**&Dn Data Terminal Ready Control**

*n* = 0, 1, 2, or 3  
 Default: **&D2**

The Data Terminal Ready (DTR) signal on pin 20 of the RS-232/V.24 interface must be high, or *on*, in order for the modem to operate. A high DTR signal tells the modem that the computer it is connected to is ready to communicate through the modem.

The DTR signal can also be used to cause the modem to reset to its default parameters, as if you had given the modem an ATZ command.

**&D0** (or **&D**) causes the modem to ignore the DTR signal and treat it as always on.

**&D1** causes the modem, if in online data mode, to enter command mode, issue an OK and remain connected when the DTR drops.

**&D2** causes the modem to hang up when DTR drops while the modem is in online data mode.

**&D3** causes the modem to reset when DTR drops . It will also hang up if it is online.

**&Sn Data Set Ready Control**

$n = 0$  or  $1$

Default: **&S0**

Controls the state of the Data Set Ready (DSR) signal on the RS-232/V.24 interface. Normally, DSR follows CD. You can force the signal high or allow it to act normally.

**&S0** forces DSR high (on).

**&S1** allows DSR to act normally, that is, to follow CD.

## Error Correction and Data Compression Commands

You can configure modems to any of three different V.42 modes of operation (with or without compression): non-error correction, auto-reliable, and reliable modes. You also can turn data compression on or off.

**\Nn Error Correction Modes**

$n = 0, 1, 2, 3, 4, 5,$  or  $7$

Default: **\N3**

Select the modem's error correction mode using the **\N** command.

**\N0** disables the modem's V.42 error correction capabilities, and the modem functions as a non-error correction modem with data buffering. This is the same as **&Q6**, described earlier in this chapter.

**\N1** causes the modem to function in direct mode.

**\N2** enables reliable mode, in which the modem uses its V.42 error correction capabilities for all transmissions. In reliable mode, the modem must be connected to a modem with the V.42 MNP protocol.

**\N3** enables auto-reliable mode. During the handshaking procedures at the start of the online connection, the modem queries whether the other modem is using V.42 error correction. If the modem determines that the other modem is using V.42, it switches itself into reliable (V.42) mode and enables error correction. If it determines that the other modem is not using V.42, the modem remains in non-error correction mode. (This is the same as **\N5** and **\N7**.)

**\N4** enables reliable mode, in which the modem uses its V.42 error correction capabilities for all transmissions. In reliable mode, the modem must be connected to a modem with a V.42 protocol (MNP or LAP-M).

The V.42 standard includes MNP Class 3 and 4 and LAP-M error correction methods.

**\N5** enables auto-reliable mode. During the handshaking procedures at the start of the online connection, the modem queries whether the other modem is using V.42 error correction. If the modem determines that the other modem is using V.42, it switches itself into reliable (V.42) mode and enables error correction. If it determines that the other modem is not using V.42, the modem remains in non-error correction mode. (This is the same as **\N3** and **\N7**.)

**\N7** enables auto-reliable mode. During the handshaking procedures at the start of the online connection, the modem queries whether the other modem is using V.42 error correction. If the modem determines that the other modem is using V.42, it switches itself into reliable (V.42) mode and enables error correction. If it determines that the other modem is not using V.42, the modem remains in non-error correction mode. (This is the same as **\N3** and **\N5**.)

**%Cn Data Compression**  
*n* = 0 or 1  
 Default: %C1

The %C command allows you to disable data compression. Data compression is normally enabled.

%C0 disables V.42bis/MNP 5 data compression.

%C1 enables V.42bis/MNP 5 data compression.

## Immediate Action Commands

Use immediate action commands to obtain information about AT commands and current modem settings.

**A/ Repeat Last Command**  
 Default: None

Type **A/** to repeat the previous command. Do not precede this command with **AT** or press ENTER to execute it.

**In Information Request**  
*n* = 0  
 Default: none

This command displays specific product information about your modem.

**I0** or **I** returns the controller firmware version number. Use this command to identify your modem's firmware level before calling Multi-Tech Technical Support. (Same as **I3**.)

**&Bn Dummy command**  
**&V View Current Configuration**  
 Default: none

Use the **&V** command to display the active modem settings.

## Flow Control Commands

Flow control refers to techniques used by data terminal equipment and the modem to pause and resume the flow of information between them. It prevents a device from accepting more data than it can handle. The modem implements flow control in both directions. When the modem halts the flow of data, it is called flow control. When the computer halts the flow, it is called pacing.

**&Kn Local Flow Control Selection**  
*n* = 0, 3, or 4  
 Default: **&K3**

Allows you to disable flow control and enable hardware or software flow control.

**&K0** completely disables data flow control initiated by the modem. (Same as **\Q0**.)

**&K3** enables modem's use of Clear to Send (CTS) signal on the RS-232/V.24 interface to regulate data flow. When CTS drops, data flow is suspended until the signal goes *high* (on) again. This method of flow control works in conjunction with pacing (i.e., computer-initiated flow control), which uses the Request to Send (RTS) signal on the RS-232/V.24 interface. Hardware flow control cannot be enabled unless an active error correction protocol is selected. This is the factory default setting. (This is the same as **\Q3**.)

**&K4** enables XON/XOFF software flow control. XON/XOFF flow control is an in-band method of data flow regulation. In-band data regulation means that the XON (^Q) and XOFF (^S) characters are inserted into the stream of data rather than using separate control lines. When an XOFF character is detected, the data stream is suspended until an XON character is detected. If you issue the **&K4** command to the modem, it will respond to XON/XOFF pacing, and use XON/XOFF characters as its own method of flow control to the computer. (This is the same as **\Q1**.)

The drawback to using this method of pacing is that some files may contain these characters as part of the file data. If such a file is transferred using a modem with XON/XOFF flow control enabled, the file transfer could fail due to indefinite suspension.

**\Qn    Local Flow Control Selection**

*n* = 0, 1, or 3

Default: **\Q3**

Allows you disable flow control and enable hardware or software flow control.

**\Q0** completely disables data flow control initiated by the modem. (This is the same as **&K0**.)

**\Q1** enables XON/XOFF software flow control. XON/XOFF flow control is an in-band method of data flow regulation. In-band data regulation means that the XON (^Q) and XOFF (^S) characters are inserted into the stream of data rather than using separate control lines. When an XOFF character is detected, the data stream is suspended until an XON character is detected. If you issue the **&K4** command to the modem, it will respond to XON/XOFF pacing, and use XON/XOFF characters as its own method of flow control to the computer. (This is the same as **&K4**.)

The drawback to using this method of pacing is that some files may contain these characters as part of the file data. If such a file is transferred using a modem with XON/XOFF flow control enabled, the file transfer could fail due to indefinite suspension.

**\Q3** enables modem's use of Clear to Send (CTS) signal on the RS-232/V.24 interface to regulate data flow. When CTS drops, data flow is suspended until the signal goes *high* (on) again. This method of flow control works in conjunction with pacing (i.e., computer-initiated flow control), which uses the Request to Send (RTS) signal on the RS-232/V.24 interface. Hardware flow control cannot be enabled unless an active error correction protocol is selected. This is the factory default setting. (This is the same as **&K3**.)

**\Xn    XON/XOFF Pass-Through**

*n* = 0, 1

Default: **\X0**

When XON/XOFF pacing is active, the local modem has two options regarding the XON and XOFF characters. It can respond to and discard the characters from the computer, or it can respond to the characters and pass them through the data communications link to the remote modem, thereby pacing the remote modem as well.

**\X0** causes the modem to respond to and discard the XON and XOFF characters (default)

**\X1** causes the modem to respond to and pass on the XON and XOFF characters

**\Jn    Data Buffer Control**

*n* = 0

Default: **\J0**

**\J0** disables force line rate less than or equal to DTE rate

**\J1** enables force line rate less than or equal to DTE rate

**\Kn    Set Break Control**

*n* = 0, 1, 2, 3, 4, 5

Default: **\K5**

Determines how the modem processes a break signal received from the local DTE during an online connection.

**\K5** causes the modem to send the break to the remote modem in sequence with transmitted data, non-destructive, non-expedited.

## Escape Sequences

Escape sequences are also known as escape codes. They are used to cause the modem to enter command mode from online mode without disconnecting the call.

`+++AT<cr>` In-Band Escape Sequence

If the modem is online with a remote modem, you can cause the modem to enter command mode without disconnecting the call by typing an escape code. The default escape code used by the modem is three plus signs (+++) followed by the letters *AT*, up to 10 command characters (most typically *H*, to hang up), and ENTER. The modem then escapes to command mode, executes the command (if any), and remains in command mode. For example, to hang up the modem at the end of a call, type `+++ATH <cr>`.

### **A Force Answer Mode**

You can use the **A** command to force the modem into answer mode. Type **ATA** when in command mode to immediately bring your modem off-hook, out of command mode, into online answer mode, and to cause it to transmit its carrier signal over the phone line. If no responding carrier tone is received by your modem within 45 seconds (or by the time you specified in register **S7**), your modem stops transmitting its tone, hangs up, and goes back into command mode.

#### **On Go Back Online**

*n* = 0, 1, or 3

Default: none

Use the **O** command to bring the modem out of command mode and back into online mode. The **O** command reverses the result of entering the escape code. The **O** command brings modem into the online mode (originate or answer) it was in prior to entering command mode.

**O0** causes the modem to exit command mode and return to online data mode.

**O1** causes the modem to issue a retrain before returning to online data mode.

**O3** causes the modem to issue a rate renegotiation before returning to online data mode.

## Modem S-Registers

*S-registers* are small regions of memory where modem configuration information is stored. Whereas AT commands tell a modem *what* to do, S-registers tell the modem *how* to do it. Each S-register has a name that consists of the letter *S* and a number (**S0**, **S1**, **S2**, etc.), hence the term *S-register*. Use the **Sr?** command to read the value stored in an S-register and the **Sr=n** command to change it.

### **S0 Number of Rings Until Modem Answers**

Unit: 1 ring

Range: 0–255

Default: 0

Defines number of rings the modem waits before answering an incoming call. Default value is zero, which effectively disables the auto-answer function. When auto-answer is disabled, the modem can only answer via the **ATA** command. Set the **S0** register value to one to cause the modem to answer the call immediately after the first ring. Maximum number of rings that can be configured is 255.

### **S1 Ring Count**

Unit: 1 ring

Range: 0–255

Default: 0

Counts number of rings that have occurred. It is a *read* type of register and is seldom used in typical operation. Each time an incoming ring signal is detected, **S1** increases its value by one, up to a maximum of 255. If you set **S1** to a value other than its default value of zero, or if the value is increasing with rings, this new value remains stored in **S1** for eight seconds after the last ring is counted, after which the value reverts back to zero.



**S2 Escape Code Character**

Unit: Decimal  
Range: 0–255  
Default: 43 (+)

Defines escape code character by its decimal ASCII code. Default character is the plus (+) sign (decimal 43). **S2** can be set for any ASCII character. Setting an **S2** value greater than 127 results in no escape character, resulting in no means of entering command mode from online mode without breaking the online connection unless you use the BREAK method.

**Note:** If you change the **S2** value, you must make corresponding changes in your data communications software.

**S3 Return Character**

Unit: Decimal  
Range: 0–127  
Default: 13 (^M)

Defines carriage return character by its decimal ASCII code. Default setting is the ^M character (decimal 13), the code for ENTER on most keyboards. Can be set for any ASCII character.

**Note:** If you change the **S3** value, you must make corresponding changes in your data communications software.

**S4 Line Feed Character**

Unit: Decimal  
Range: 0–127  
Default: 10 (^J)

Defines the line feed character by its decimal ASCII code. Default setting is ^J (decimal 10), the code for the line feed key on most keyboards that have such a key. Can be set for any ASCII character.

**S5 Backspace Character**

Unit: Decimal  
Range: 0–127  
Default: 8 (^H)

Defines backspace character by its decimal ASCII code. Default setting is the ^H character (decimal 8), the code for BACKSPACE on most keyboards. Can be set for any ASCII character. Setting **S2** to a value greater than 32 disables the backspace character.

**Note:** If you change the **S5** value, you must make corresponding changes in your data communications software.

**S6 Wait Time for Dial Tone**

Unit: 1 second  
Range: 2–65 (North America), 4–255 (International), 4–7 (U.K.)  
Default: 2 (North America), 4 (International and U.K.)

Defines length of time the modem waits after ENTER is pressed before carrying out a dial command. Default setting is two seconds for North America, four seconds elsewhere.

**S7 Time to Wait for Carrier**

Unit: 1 second  
Range: 1–255 (USA), 1–45 (Canada and International), 1–55 (UK)  
Default: 50 (North America and International) or 55 (U.K.)

Determines amount of time the modem waits for a carrier signal before it disconnects. Default value is 50 seconds except the UK model, which defaults to 55 seconds. After dialing, the modem waits for a carrier signal for up to 50 or 55 seconds and if none is detected, terminates the call. Maximum **S7** value is 255 seconds for the US model, 45 seconds for Canadian and International models, and 55 seconds for the UK model. **S7** also determines the wait for silence time for the @ dial modifier.

**S8 Pause Time for Comma**

Unit: 1 second

Range: 0–65 (North America), 4–255 (International), 4–7 (UK)

Default: 2 (North America), 4 (International and UK)

Determines the length of pause caused by a comma character in a dialing command. Default setting is two seconds for North American model and four seconds for international and UK models. **S8** can be set for up to 65 seconds. **S8** also defines the length of time the modem waits before retrying a call after it detects a busy signal. Some computer systems need more than two seconds to reset. If this is the case, increase the value of **S8**.

**S10 Carrier Loss Disconnect Delay Time**

Unit: 100 ms

Range: 1–254

Default: 20

Defines the length of time, in milliseconds, that the modem waits after a loss of carrier signal before the it disconnects. The default setting is 2000 ms (20 units of 100 ms each). Maximum delay is 25400 milliseconds, or 25.4 seconds (decimal 254).

**S11 Tone Dialing Spacing and Duration**

Unit: 1 ms

Range: 50 - 150 (US) or 80–255 (Canada, UK, International)

Default: 95 (US) or 80 (Canada, UK, International)

Sets the speed of tone dialing (spacing and tone duration times). The default value is 95 units for domestic models and 80 units for Canadian and International models, where each unit is one ms. In other words, for domestic modems, each tone is sustained for 95 ms followed by a 95 ms pause. The minimum **S11** value allowed is 50 ms (50 units). The maximum S11 value is 150 ms (150 units).

**S28 Enable / Disable V.34 Modulation**

Unit: decimal

Range: 0, 1–255

Default: 1 (enabled)

Enables or disables V.34 modulation. Setting **S28** to zero (0) disables V.34 modulation. Any other setting (1-255) enables V.34 modulation.

**S35 Data Calling Tone**

Unit: decimal

Range: 0–1

Default: 0 (disabled)

Enables or disables the V.25 data calling tone, which allows remote data, fax and voice discrimination. Setting **S35** to zero (0) disables V.25 data calling tone; setting **S35** to 1 enables data calling tone. The default setting is 1.

**S37 Maximum Dial Line Rate**

Unit: decimal

Range: 0–19

Default: 0

Sets the maximum dial line rate. When set to zero (0), the maximum dial line rate is the same as the maximum modem speed. This is the most common setting and allows other modem functions to actually determine the line rate used for each connection. It is the default. Consider using **S37** to set a maximum dial line rate if you need to artificially retain a lower modem speed.

- |                         |                |
|-------------------------|----------------|
| 0 = maximum modem speed | 11 = 14400 bps |
| 1 = reserved            | 12 = 16800 bps |
| 2 = 1200/75 bps         | 13 = 19200 bps |
| 5 = 1200 bps            | 14 = 21600 bps |

6 = 2400 bps	15 = 24000 bps
7 = 4800 bps	16 = 26400 bps
8 = 7200 bps	17 = 28800 bps
9 = 9600 bps	18 = 31200 bps
10 = 12000 bps	19 = 33600 bps

**S42 Enable / Disable Auto Rate**

Unit: decimal  
 Range: 0-1  
 Default: 1 (enabled)

Enables and disables the 56K auto rate. Retrain and fallback are disabled in data mode. Set **S42** to zero (0) to disable auto rate, or 1 (the default) to enable auto rate.

**S43 Enable / Disable V.32bis Start-up Auto Mode**

Unit: decimal  
 Range: 0-1  
 Default: 1 (enabled)

*Used for testing and debugging only.* Enables and disables V.32bis start-up auto mode operation. Set **S43** to zero (0) to disable start-up auto mode, or 1 (the default) to enable start-up auto mode.

**S89 Off-line Time**

Unit: 1 second  
 Range: 0, 5-255  
 Default: 0

Sets the length of time, in seconds, a modem waits in the off-line command mode before it goes into standby mode. If **S89** is set to 20 seconds, the modem waits 20 seconds in off-line command mode before going into standby mode. Setting **S89** to zero (0) prevents the modem from ever entering standby mode.

Setting **S89** to any value between zero and five (1-4) effectively sets the value to five, because five seconds is the minimum possible wait time.

**S108 Line Code Control**

Unit: Decimal  
 Range: 0, 1  
 Default: 1

Controls the line coding used by the modem.

S108 = 0      mu-law  
 S108 = 1      A-law (default)

**S109 PCM Mode Control**

Unit: Decimal  
 Range: 0-2  
 Default: 1

Controls the PCM ( pulse code modulation) mode (V.90 or K56Flex). Determines which mode the modem will answer in for PCM connections.

S109 = 0      K56Flex support only  
 S109 = 1      Both V.90 and K56Flex supported  
 S109 = 2      V.90 support only

## Reading and Assigning S-Register Values

Use the **S** command to assign a value to an S-register and to read an it's current value. To read an S-register value, in terminal mode, type **S**, the S-register number, and a question mark (?), and press ENTER. For example, to display the value of register **S7**, type **ATS7?** and press ENTER. The value appears as a three-digit decimal number (e.g., *045*).

To assign a new value to an S-register, type **S**, the S-register number, an equals sign (=), and a decimal number. Convert all ASCII characters to their decimal equivalents before entering. Valid S-register decimal values are shown for each register in the previous section. To make the change permanent, use the **&W0** command.

### Examples of Assigning Values

1. You want to have longer pauses caused by the comma in a dial command: five seconds instead of two. Type **ATS8=5** to assign 5 as the value for register **S8**. The modem now pauses five seconds for every comma in a dial command.
2. You want to configure your modem to answer incoming calls after the fourth ring instead of after the first ring. To configure register **S0** with a value of 4, type **ATS0=4** and press ENTER.
3. You are calling long distance to another country code, and it is taking a long time to connect. The register **S7** (time to wait for carrier) factory default setting of 50 seconds is insufficient; a time-out occurs and cancels the call before a connection is made. To change the **S7** value to 75 seconds, type **ATS7=75** and press ENTER. Now, after dialing, the modem allows 25 more seconds for a carrier signal before aborting the call. The additional 25 seconds should provide enough time for international calls.

### Examples of Reading Values

1. To verify that you entered the value correctly in the preceding examples, type **ATS8?** and press ENTER in the first example, **ATS0?** in the second example, and **ATS2?** in the third example. You should receive the responses *005*, *004*, and *075*, respectively.
2. When configuring S-registers, it is a good practice to include the verification read command in the same command string as the configuration assignment command. In the three preceding examples, type **ATS8=5S8?**, **ATS0=4S3?**, and **ATS7=75S7?**, respectively.

## AT Commands that Affect S-Registers

For maximum throughput, the ISIHP's default configuration is for originating a call to another 33,600 bps modem that supports error correction, data compression, and flow control. If the receiving modem is not compatible, the ISIHP can match any ITU-T or Bell standard modem (but not proprietary protocols).

If you require a different configuration for your application—for example, if you want to use an ISIHP modem strictly as an auto answering device or for service that does not support error correction—you can change the command parameters and S-register values in active memory and save the new values with the **&W** command.

The **&W0** (or **&W**) command stores all current AT command and S-register values into nonvolatile random access memory (NVRAM) and configures the modem so that it reads your custom settings in NVRAM when the modem is turned on or when it is reset with the **Z** command. (The **&F** reset command will continue to read the factory default settings in read-only memory [ROM].) For convenience, you can include the **&W** command in the same command string that sets the new values in active memory as in the following example: `AT\N2&C1S0=10&W0<cr>`

---

## Modem Result Codes

Terse	Verbose	Definition
0	OK	Command executed without error; ready for next command.
1	CONNECT	Modem has detected carrier and gone online.
2	RING	Modem has detected ring caused by incoming call.
3	NO CARRIER	No carrier signal has been detected within the allowed time.
4	ERROR	Error in command line (too many, or invalid characters).
5	CONNECT 1200	Modem detected carrier at 1200 bps and gone online.
6	NO DIALTONE	No dial tone detected.
7	BUSY	Busy signal detected.
8	NO ANSWER	The remote system did not answer.
10	CONNECT 2400	Modem detected carrier at 2400 bps and gone online.
11	CONNECT 4800	Modem detected carrier at 4800 bps and gone online.
12	CONNECT 9600	Modem detected carrier at 9600 bps and gone online.
13	CONNECT 14400	Modem detected carrier at 14400 bps and gone online.
14	CONNECT 19200	Modem detected carrier at 19200 bps and gone online.
24	CONNECT 7200	Modem detected carrier at 7200 bps and gone online.
2	CONNECT 12000	Modem detected carrier at 12000 bps and gone online.
86	CONNECT 16800	Modem detected carrier at 16800 bps and gone online.
40	CONNECT 300	Modem detected carrier at 300 bps and gone online.
55	CONNECT 21600	Modem detected carrier at 21600 bps and gone online.
56	CONNECT 24000	Modem detected carrier at 24000 bps and gone online.
57	CONNECT 26400	Modem detected carrier at 26400 bps and gone online.
58	CONNECT 28800	Modem detected carrier at 28800 bps and gone online.
59	CONNECT 31200	Modem detected carrier at 31200 bps and gone online.
60	CONNECT 33600	Modem detected carrier at 33600 bps and gone online.
	CONNECT 45000	Modem detected carrier at 45000 bps and gone online.
	CONNECT 56000	Modem detected carrier at 56000 bps and gone online.
88	DELAYED	Delay is in effect for the dialed number.
89	BLACKLISTED	The dialed number is blacklisted.
90	BLACKLIST FULL	The blacklist is full.

**Extended Result Codes.** If the extended result codes configuration option is enabled, **EC** is added to the following result codes:

5	CONNECT 1200
10	CONNECT 2400
11	CONNECT 4800
12	CONNECT 9600
13	CONNECT 14400
14	CONNECT 19200
24	CONNECT 7200
25	CONNECT 12000
86	CONNECT 16800
40	CONNECT 300
55	CONNECT 21600
56	CONNECT 24000
57	CONNECT 26400
58	CONNECT 28800
59	CONNECT 31200
60	CONNECT 33600
	CONNECT 45000
	CONNECT 56000

**EC** is replaced by one of the following codes, depending on the type of error control connection:

**Code Error Correction**

V42bis	LAP-M V.42 error control and V.42bis data compression
V42	LAP-M V.42 error control only
MNP5	MNP4 error control and MNP 5 data compression
MNP4	MNP 4 error control only
NoEC	No error control protocol



## Glossary of Terms



## A

**Access:** The T1 line element made up of two pairs of wire that the phone company brings to the customer premises. The Access portion ends with a connection at the local telco (LEC or RBOC).

**Accunet Spectrum of Digital Services (ASDS):** The AT&T 56K bps leased (private) line service. Similar to services of MCI and Sprint. ASDS is available in nx56/64K bps, where n=1, 2, 4, 6, 8, 12.

**ACK (ACKnowledgement code) (pronounced “ack”):** A communications code sent from a receiving modem to a transmitting modem to indicate that it is ready to accept data. It is also used to acknowledge the error-free receipt of transmitted data. Contrast with NAK.

**Adaptive Differential Pulse Code Modulation (ADPCM):** In multimedia applications, a technique in which pulse code modulation samples are compressed before they are stored on a disk. ADPCM, an extension of the PCM format, is a standard encoding format for storing audio information in a digital format. It reduced storage requirements by storing differences between successive digital samples rather than full values.

**Address:** A numbered location inside a computer. It's how the computer accesses its resources, like a video card, serial ports, memory, etc.

**AMI line coding:** One of two common methods of T1 line coding (with B8ZS). AMI line coding places restrictions on user data (B8ZS does not).

**Analog signal:** A waveform which has amplitude, frequency and phase, and which takes on a range of values between its maximum and minimum points.

**Analog Transmission:** One of two types of telecommunications which uses an analog signal as a carrier of voice, data, video, etc. An analog signal becomes a carrier when it is modulated by altering its phase, amplitude and frequency to correspond with the source signal. Compare with digital transmission.

**Application Program Interface (API):** A software module created to allow dissimilar, or incompatible applications programs to transfer information over a communications link. APIs may be simple or complex; they are commonly required to link PC applications with mainframe programs.

**ASCII (American Standard Code for Information Interchange) (pronounced “askey”):** A binary code for data that is used in communications and in many computers and terminals. The code is used to represent numbers, letters, punctuation and control characters. The basic ASCII code is a 7-bit character set which defines 128 possible characters. The extended ASCII file provides 255 characters.

**Asynchronous Transfer Mode (ATM):** A very high-speed method of transmission that uses fixed-size cells of 53 bytes to transfer information over fiber; also known as cell relay.

**AT Commands:** A standard set of commands used to configure various modem parameters, establish connections and disconnect. The “AT” is used to get the “attention” of the modem before the actual command is issued.

**Availability:** The measure of the time during which a circuit is ready for use; the complement of circuit “outage” (100% minus % outage = % available).

## B

**B7ZS (Bipolar 7 Zero Suppression) line coding:** One method of T1 line coding (see also “B8ZS” and “AMI”). B7ZS line coding does not place restrictions on user data (AMI does).

**B8ZS (Bipolar 8 Zero Suppression) line coding:** One of two common methods of T1 line coding (with AMI). B8ZS line coding does not place restrictions on user data (AMI does). A coding method used to produce 64K bps “clear” transmission. (See also “B7ZS” and “AMI” line coding)

**Backbone:** 1. A set of nodes and their interconnecting links providing the primary data path across a network. 2. In a local area network multiple-bridge ring configuration, a high-speed link to which the rings are connected by means of bridges. A backbone may be configured as a bus or as a ring. 3. In a wide area network, a high-speed link to which nodes or data switching exchanges (DSEs) are connected. 4. A common distribution core that provides all electrical power, gases, chemicals, and other services to the sectors of an automated wafer processing system.

**Background:** An activity that takes place in the PC while you are running another application. In other words, the active user interface does not correspond to the ‘background’ task.

**Bandwidth:** The transmission capacity of a computer channel, communications line or bus. It is expressed in cycles per second (hertz), the bandwidth being the difference between the lowest and highest frequencies transmitted. The range of usable frequencies that a transmission medium will pass without unacceptable attenuation or distortion. Bandwidth is a factor in determining the amount of information and the speed at which a medium can transmit data or other information.

**Backward Explicit Congestion Notification (BECN):** A bit that tells you that a certain frame on a particular logical connection has encountered heavy traffic. The bit provides notification that congestion-avoidance procedures should be initiated in the opposite direction of the received frame. See also FECN (Forward Explicit Congestion Notification).



**Basic Rate Interface (BRI):** An ISDN access interface type comprised of two B-channels each at 64K bps and one D-channel at 64K bps (2B+D).

**Bell Operating Companies (BOC):** The family of corporations created during the divestiture of AT&T. BOCs are independent companies which service a specific region of the US. Also called Regional Bell Operating Companies (RBOCs).

**Bell Pub 41450:** The Bell publication defining requirements for data format conversion, line conditioning, and termination for direct DDS connection.

**Bell Pub 62310:** The Bell publication defining requirements for data format conversion, line conditioning, and termination for direct DDS connection.

**Binary Synchronous Communication (BSC):** A form of telecommunication line control that uses a standard set of transmission control characters and control character sequences, for binary synchronous transmission of binary-coded data between stations.

**Bit (Binary digit):** A bit is the basis of the binary number system. It can take the value of 1 or 0. Bits are generally recognized as the electrical charge generated or stored by a computer that represent some portion of usable information.

**Bit Error Rate Test (BERT):** A device or routine that measures the quality of data transmission. A known bit pattern is transmitted, and the errors received are counted and a BER (bit error rate) is calculated. The BER is the ratio of received bits in error relative to the total number of bits received, expressed in a power of 10.

**Bit robbing:** The use of the least significant bit per channel in every sixth frame for signaling. The line signal bits "robbed" from the speech part conveys sufficient pre-ISDN telephony signaling information with the remaining line signal bits providing sufficient line signaling bits for recreating the original sound. See "robbed bit signaling".

**Blue Alarm:** An error indication signal consisting of all 1s indicating disconnection or attached device failure. Contrast "Red Alarm" and "Yellow Alarm".

**Bps (bits per second):** A unit to measure the speed at which data bits can be transmitted or received. Bps differs from baud when more than one bit is represented by a single cycle of the carrier.

**Bridges:** 1. A functional unit that interconnects two local area networks that use the same logical link protocol but may use different medium access control protocols. 2. A functional unit that interconnects multiple LANs (locally or remotely) that use the same logical link control protocol but that can use different medium access control protocols. A bridge forwards a frame to another bridge based on the medium access control (MAC) address. 3. In the connection of local loops, channels, or rings, the equipment and techniques used to match circuits and to facilitate accurate data transmission.

**Buffer:** A temporary storage register or Random Access Memory (RAM) used in all aspects of data communications which prevents data from being lost due to differences in transmission speed. Keyboards, serial ports, muxes and printers are a few examples of the devices that contain buffers.

**Bus:** A common channel between hardware devices either internally between components in a computer, or externally between stations in a communications network.

**Byte:** The unit of information a computer can handle at one time. The most common understanding is that a byte consists of 8 binary digits (bits), because that's what computers can handle. A byte holds the equivalent of a single character (such as the letter A).

## C

**Call Setup Time:** The time to establish a circuit-switched call between two points. Includes dialing, wait time, and CO/long distance service movement time.

**Carrier Group Alarm (CGA):** A T1 service alarm generated by a channel bank when an OOF condition occurs for a predefined length of time (usually 300mS to 2.5 seconds). The CGA causes the calls using a trunk to be dropped and for trunk conditioning to be applied.

**Carrier signal:** An analog signal with known frequency, amplitude and phase characteristics used as a transport facility for useful information. By knowing the original characteristics, a receiver can interpret any changes as modulations, and thereby recover the information.

**CCITT (Consultative Committee for International Telephone and Telegraph):** An advisory committee created and controlled by the United Nations and headquartered in Geneva whose purpose is to develop and to publish recommendations for worldwide standardization of telecommunications devices. CCITT has developed modem standards that are adapted primarily by PTT (post, telephone and telegraph) organizations that operate phone networks of countries outside of the U.S. See also ITU.

**Central Office (CO):** The lowest, or most basic level of switching in the PSTN (public switched telephone network). A business PABX or any residential phone connects to the PSTN at a central office.

**Centrex:** A multi-line service offered by operating telcos which provides, from the telco CO, functions and features comparable to those of a PBX for large business users. See also "Private Branch Exchange", "Exchange".

**Channel:** A data communications path between two computer devices. Can refer to a physical medium (e.g., UTP or coax), or to a specific carrier frequency.

**Channel Bank:** A device that acts as a converter, taking the digital signal from the T1 line into a phone system and converting it to the analog signals used by the phone system. A channel bank acts as a multiplexer, placing many low-speed voice or data transactions on a single high-speed link.

**Circuit-switched Network:** A technology used by the PSTN that allocates a pair of conductors for the exclusive use of one communication path. Circuit switching allows multiple conversations on one talk path only if the end-users multiplex the signals prior to transmission.

**Circuit Switching:** The temporary connection of two or more communications channels using a fixed, non-shareable path through the network. Users have full use of the circuit until the connection is terminated.

**Clear Channel:** A transmission path where the full bandwidth is used (i.e., no bandwidth needed for signaling, carrier framing or control bits). A 64K bps digital circuit usually has 8K bps used for signaling. ISDN has two 64K bps circuits, and a 16K bps packet service of which part is used for signaling on the 64K channels.

**Client-Server:** In TCP/IP, the model of interaction in distributed data processing in which a program at one site sends a request to a program at another site and awaits a response. The requesting program is called a client; the answering program is called a server.

**Cluster Controller:** A device that can control the input/output operations of more than one device connected to it. A cluster controller may be controlled by a program stored and executed in the unit, or it may be entirely controlled by hardware.

**Committed Burst Size:** The maximum number of bits that the frame relay network agrees to transfer during any measurement interval.

**Committed Information Rate (CIR):** An agreement a customer makes to use a certain minimum data transmission rate (in bps). The CIR is part of the frame relay service monthly billing, along with actual usage, that users pay to their frame relay service provider.

**Compression:** 1. The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks. 2. In SNA, the replacement of a string of up to 64-repeated characters by an encoded control byte to reduce the length of the data stream to the LU-LU session partner. The encoded control byte is followed by the character that was repeated (unless that character is the prime compression character). 3. In Data Facility Hierarchical Storage Manager, the process of moving data instead of allocated space during migration and recall in order to release unused space. 4. Contrast with decompression.

**COMx Port:** A serial communications port on a PC.

**Congestion:** A network condition where there is too much data traffic. The ITU I.233 standard defines congestion management in terms of speed and burstiness.

**Congestion Notification:** The function in frame relay that ensures that user data transmitted at a rate higher than the CIR are allowed to slow down to the rate of the available network bandwidth.

**Consecutive Severely Errored Seconds (CSES):** An error condition that occurs when from 3 to 9 SES (Severely Errored Seconds) are logged consecutively.

**Customer Premise Equipment (CPE):** The generic term for data comm and/or terminal equipment that resides at the user site and is owned by the user with the following exclusions: Over voltage protection equipment, inside wiring, coin operated or pay telephones, "company-official" equipment, mobile telephone equipment, "911" equipment, equipment necessary for the provision of communications for national defense, or multiplexing equipment used to deliver multiple channels to the customer.

## D

**D4:** the T1 4th generation channel bank.

**D4 channelization:** Refers to the compliance with AT&T TR 62411 for DS1 frame layout.

**D4 framing:** The T1 format for framing in AT&T D-Series channel banks, in which there are 12 separate 193-bit frames in a super-frame. A D4 framing bit is used to identify the channel and the signaling frame. Signalling for voice channels is carried in-band for every channel, along with the encoded voice. See "robbed-bit signaling".

**Data Communications Equipment (DCE):** Any device which serves as the portal of entry from the user equipment to a telecommunications facility. A modem is a DCE for the telephone network (PSTN) that is commonly on site at the user's premises. Packet Switched Networks have another level of DCE which is most often located at a central office.

**Data Link Connection Identifier (DLCI):** One of the six components of a frame relay frame. Its purpose is to distinguish separate virtual circuits across each access connection. Data coming into a frame relay node is thus allowed to be sent across the interface to the specified "address". The DLCI is confirmed and relayed to its destination, or if the specification is in error, the frame is discarded.

**Dataphone Digital Service (DDS):** A private line digital service that offers 2400, 4800, 9600 and 56K bps data rates on an

inter-LATA basis by AT&T and on an intra-LATA basis by the BOCs.

**Data Service Unit (DSU):** A device that provides a digital data service interface directly to the data terminal equipment. The DSU provides loop equalization, remote and local testing capabilities, and a standard EIA/CCITT interface.

**Dedicated Line:** A communication line that is not switched. The term leased line is more common.

**Default:** This is a preset value or option in software packages, or in hardware configuration, that is used unless you specify otherwise.

**Device driver:** Software that controls how a computer communicates with a device, such as a printer or mouse.

**Digital Cross-connect System (DCS):** The CO device which splits and redistributes the T1 bandwidth. The DCS takes time slots from various T1 lines and alters them to provide the needed connectivity. DCS connections are made with software at an administrator's workstation.

**Digital Data:** Information represented by discrete values or conditions (contrast "Analog Data").

**Digital Loopback:** A technique used for testing the circuitry of a communications device. Can be initiated locally, or remotely (via a telecommunications device). The tested device decodes and encodes a received test message, then echoes the message back. The results are compared with the original message to determine if corruption occurred en route.

**Digital PBX:** A Private Branch Exchange that operates internally on digital signals. See also "Exchange".

**Digital Service, level 0 (DS0):** The worldwide standard speed (64 Kbps) for digital voice conversation using PCM (pulse coded modulation).

**Digital Service, level 1 (DS1):** The 1.544 Mbps voice standard (derived from an older Bell System standard) for digitized voice transmission in North America. The 1.544 Mbps consists of 24 digitally-encoded 64 Kbps voice channels (north America) and 2.048 Mbps (30 channels) elsewhere.

**Digital Signal:** A discrete or discontinuous signal (e.g., a sequence of voltage pulses). Digital devices, such as terminals and computers, transmit data as a series of electrical pulses which have discrete jumps rather than gradual changes.

**Digital Signaling Rates (DSn):** A hierarchical system for transmission rates, where "DS0" is 64K bps (equivalent to ISDN B channel), and DS1 is 1.5 Mbps (equivalent to ISDN PRI).

**Digital Transmission:** A method of electronic information transmission common between computers and other digital devices. Analog signals are waveforms: a combination of many possible voltages. A computer's digital signal may be only "high" or "low" at any given time. Therefore, digital signals may be "cleaned up" (noise and distortion removed) and amplified during transmission.

**Digitize:** To convert an analog signal to a digital signal.

**DIP switch (pronounced "dip switch"):** A set of tiny toggle switches, built into a DIP (dual in-line package), used for setting configurable parameters on a PCB (printed circuit board).

**Driver:** A software module that interfaces between the Operating System and a specific hardware device (e.g., color monitors, printers, hard disks, etc.). Also known as a device driver.

**Drop and Insert:** The process where a portion of information carried in a transmission system is demodulated ("Dropped") at an intermediate point and different information is included ("Inserted") for subsequent transmission.

**DTE (Data Terminal Equipment):** A term used to include any device in a network which generates, stores or displays user information. DTE is a telecommunications term which usually refers to PCs, terminals, printers, etc.

**DTMF (Dual-Tone MultiFrequency):** A generic push-button concept made popular by AT&T TouchTone.

## E

**E&M:** A telephony trunking system used for either switch-to-switch, or switch-to-network, or computer/telephone system-to-switch connection.

**EIA:** The Electronics Industries Association is a trade organization in Washington, DC that sets standards for use of its member companies. (See RS-232, RS-422, RS530.)

**Encapsulation:** A technique used by network-layer protocols in which a layer adds header information to the protocol data unit from the preceding layer. Also used in "enveloping" one protocol inside another for transmission. For example, IP inside IPX.

**Errored Seconds (ES):** Any second of operation that all 1.544M bits are not received exactly as transmitted. Contrast "Error Free Seconds".

**Error Free Seconds (EFS):** Any second of operation that all 1.544M bits are received exactly as transmitted. Contrast "Errored Seconds".

**ESF Error Event:** A T1 error condition that is logged when a CRC-6 error or an out-of-frame (OOF) error occurs.

**Ethernet:** A 10-megabit baseband local area network that allows multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and transmission. Ethernet uses carrier sense multiple access with collision detection (CSMA/CD).

**Excess Zeros:** A T1 error condition that is logged when more than 15 consecutive 0s or fewer than one 1 bit in 16 bits occurs.

**Exchange:** A unit (public or private) that can consist of one or more central offices established to serve a specified area. An exchange typically has a single rate of charges (tariffs) that has previously been approved by a regulatory group.

**Exchange Area:** A geographical area with a single uniform set of charges (tariffs), approved by a regulatory group, for telephone services. Calls between any two points within an exchange area are local calls. See also "Digital PBX", "PBX".

**Exchange Termination (ET):** The carrier's local exchange switch. Contrast with "Loop Termination - LT".

**Explicit Congestion Management:** The method used in frame relay to notify the terminal equipment that the network is overly busy. The use of FECN and BECN is called explicit congestion management. Some end-to-end protocols use FECN or BECN, but usually not both options together. With this method, a congestion condition is identified and fixed before it becomes critical. Contrast with "implicit congestion".

**Extended Super Frame (ESF):** One of two popular formats for framing bits on a T1 line. ESF framing has a 24-frame super-frame, where robbed bit signaling is inserted in the LSB (bit 8 of the DS-0 byte) of frames 6, 12, 18 and 24. ESF has more T1 error measurement capabilities than D4 framing. Both ESF and B8ZS are typically offered to provide clear channel service.

## F

**Failed Seconds:** A test parameter where the circuit is unavailable for one full second.

**Failed Signal:** A T1 test parameter logged when there are more than 9 SES (Severely Errored Seconds).

**Fax (facsimile):** Refers to the bit-mapped rendition of a graphics-oriented document (fax) or to the electronic transmission of the image over telephone lines (faxing). Fax transmission differs from data transmission in that the former is a bit-mapped approximation of a graphical document and, therefore, cannot be accurately interpreted according to any character code.

**Firmware:** A category of memory chips that hold their content without electrical power, they include ROM, PROM, EPROM and EEPROM technologies. Firmware becomes "hard software" when holding program code.

**Foreground:** The application program currently running on and in control of the PC screen and keyboard. The area of the screen that occupies the active window. Compare with "background".

**Fractional T1 (FT1):** A digital data transmission rate between 56K bps (DS0 rate) and 1.544M bps (the full T1 rate - in North America). FT1 is typically provided on 4-wire (two copper pairs) UTP. Often used for video conferencing, imaging and LAN interconnection due to its low cost and relatively high speed. FT1 rates are offered in 64K bps multiples, usually up to 768K bps.

**Frequency:** A characteristic of an electrical or electronic signal which describes the periodic recurrence of cycles. Frequency is inversely proportional to the wavelength or pulse width of the signal (i.e., long wavelength signals have low frequencies and short wavelength signals yield high frequencies).

**Foreign Exchange (FX):** A CO trunk with access to a distant CO, allowing ease of access and flat-rate calls anywhere in the foreign exchange area.

**Foreign Exchange Office (FXO):** provides local telephone service from a CO outside of ("foreign" to) the subscriber's exchange area. In simple form, a user can pick up the phone in one city and receive a tone in the foreign city. Connecting a POTS telephone to a computer telephony system via a T1 link requires a channel bank configured for the FX connection. To generate a call from the POTS set to the computer telephony system, a FXO connection must be configured.

**Foreign Exchange Station (FXS):** See FX, FXO. To generate a call from the computer telephony system to the POTS set, an FXS connection must be configured.

**Forward Explicit Congestion Notification (FECN):** A bit that tells you that a certain frame on a particular logical connection has encountered heavy traffic. The bit provides notification that congestion-avoidance procedures should be initiated in the same direction of the received frame. See also BECN (Backward Explicit Congestion Notification).

**Frame:** A group of data bits in a specific format to help network equipment recognize what the bits mean and how to process them. The bits are sent serially, with a flag at each end signifying the start and end of the frame.

**Frame Relay:** A form of packet switching that uses small packets and that requires less error checking than other forms of packet switching. Frame relay is effective for sending "bursty" data at high speeds (56/64K, 256K, and 1024K bps) over wide area networks. Frame Relay specifications are defined by ANSI documents ANSI T1.602, T1.606, T1S1/90-175, T1S1/90-213, and T1S1/90-214. In using frame relay, blocks of information (frames) are passed across a digital network interface using a "connection number" that is applied to each frame to distinguish between individual frames.

**Frame Relay Forum:** A non-profit organization of 300+ vendors and service providers, based in Foster City, CA, that are

developing and deploying frame relay equipment.

**Frame Relay Implementors Forum:** A group of companies supporting a common specification for frame relay connection to link customer premises equipment to telco network equipment. Their specification supports ANSI frame relay specs and defines extensions such as local management.

**Frame Relay Access Device (FRAD):** A piece of equipment that acts as a concentrator or frame assembler/dissassembler that can support multiple protocols and provide basic "routing" functions.

## G

**Gateway:** 1. A functional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architectures. 2. A network that connects hosts.

**Graphical User Interface (GUI):** A type of computer interface consisting of a visual metaphor of a real-world scene, often of a desktop. Within that scene are icons, representing actual objects, that the user can access and manipulate with a pointing device.

## H

**Handshaking:** A process that two modems go through at the time of call setup to establish synchronization over the data communications link. It is a synchronization and negotiation process accomplished by the exchange of predefined, mutually recognized control codes.

**High-level Data Link Control (HDLC):** An ISO standard, bit-oriented data communications protocol that provides nearly error-free data transfers.

## I

**Hexadecimal:** A base 16 numbering system used to represent binary values. Hex uses the numbers 0-9 and the letters A-F: usually notated by an "h" (e.g., "4CF h", read "four charley fox, hex"). The result is that one hex digit represents a 4-bit value.

**Implicit congestion management:** A method of informing the terminal that the network is busy. This method relies on the end-system protocol to detect and fix the congestion problem. (TCP/IP is an example of a protocol using only implicit congestion management.) See also "explicit congestion management".

**In-band:** Refers to the type of signalling over the conversation path on an ISDN call. Contrast "out-of-band".

**Insufficient Ones:** A T1 error condition that is logged when fewer than one 1 in 16 0s or less than 12.5 % average 1s density is received.

**Inter Exchange Carrier (IEC):** The long distance company (LE) who's central office provides the point of reference for T1 access. Any common carrier authorized by the FCC to carry customer transmissions between LATAs.

**Internet:** Refers to the computer network of many millions of university, government and private users around the world. Each user has a unique Internet Address.

**Internet Address (IP Address):** A unique 32-bit address for a specific TCP/IP host on a network. Normally printed in dotted decimal format (e.g., 129.128.44.227).

**Internet Protocol (IP):** A protocol used to route data from its source to its destination in an Internet environment. The Internet Protocol was designed to connect local area networks. Although there are many protocols that do this, IP refers to the global system of interconnecting computers. It is a highly distributed protocol (each machine only worries about sending data to the next step in the route).

**Internetwork Packet Exchange (IPX):** A NetWare communications protocol used to route messages from one node to another. IPX packets include network addresses and can be routed from one network to another. An IPX packet can occasionally get lost when crossing networks, thus IPX does not guarantee delivery of a complete message. Either the application has to provide that control, or NetWare's SPX protocol must be used.

**Interoperable:** Devices from different vendors that can exchange information using a standard's base protocol.

**I/O Addresses:** Locations within the I/O address space of your computer used by a device, such as an expansion card, a serial port, or an internal modem. The address is used for communication between software and a device.

**IRQ Level (Interrupt Request Level):** The notification a processor receives when another portion of the computer's hardware requires its attention. IRQs are numbered so that the device issuing the IRQ can be identified, and so IRQs can be prioritized.

**ISA (Industry Standards Architecture) (pronounced "ice a"):** The classic 8 or 16-bit architecture introduced with IBM's PC-AT computer.

**ISDN (Integrated Services Digital Network):** An International telecommunications standard for transmitting voice, video

and data over a digital communications line. ISDN is a world-wide telecommunications service that uses digital transmission and switching technology to support voice and digital data communications. Frame relay was partially based on ISDN's data link layer protocol (LAPD). Frame relay can be used to transmit across ISDN services offering circuit-switched connection at 64K bps and higher speeds. Contrast Public Switched Telephone Network (PSTN).

**ITU-TSS (formerly CCITT):** International Telecommunications Union-Telecommunications Sector; the United Nations organization that prepares standards ("Recommendations") for resolving communications issues and problems.

### J

No Entries.

### K

**Key Telephone System (KTS):** Phone devices with multiple buttons that let you select incoming or outgoing CO phone lines directly. Similar in operation to a PBX, except with a KTS you don't have to dial a "9" to call outside the building.

**Key Service Unit (KSU):** A small device containing the switching electronics for a business key telephone system (KTS).

**Key Set:** A phone set with several buttons for call holding, line pickup, intercom, autodialing, etc. Also called a touchtone phone (Ericsson) and a KTS (Key Telephone Set).

### L

**LAPB:** Link Access Procedure Balanced; based on the X.25 Layer 2 specification. A full-duplex, point-to-point, bit-synchronous protocol commonly used as a data link control protocol to interface X.25 DTEs. LAPB is the link initialization procedure that establishes and maintains communications between the DTE and the DCE.

**LAPD:** Link Access Protocol for the D-Channel; based on the ISDN Q.921 specification. A full-duplex point-to-point bit-synchronous link-level protocol for ISDN connections; different from LAPB in its framing sequence. Transmission is in units called "frames", and a frame may contain one or more X.25 packets.

**Line Coding:** The representation of 1s and 0s on a T1 line. The two methods of line coding commonly used, B8ZS and AMI, differ in the restrictions placed on user data. T1 line coding ensures that sufficient timing information is sent with the digital signal to ensure recovery of all the bits at the far end. Timing information on the T1 line is included in the form of 1s in the data stream; a long string of 0s in the data stream could cause problems recovering the data.

**Line Termination (LT):** The electronics at the ISDN network side of the user/network interface that complements the NT1 at the user side. The LT and the NT1 together provide the high-speed digital line signals required for BRI access.

**Listed Directory Number (LDN):** The main number assigned by the telco; the number listed in the phone directory and also provided by Directory Assistance. Some devices can have more than one LDN, such as ISDN devices that have one LDN for voice and another LDN for data.

**Local Area Network (LAN):** 1. A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. 2. A LAN does not use store-and-forward techniques. 3. A network in which a set of devices are connected to one another for a communication and that can be connected to a larger network.

**Local Access and Transport Area (LATA):** A post-divestiture geographical area generally equivalent to a Standard Metropolitan Statistical Area. At divestiture, the territory served by the Bell system was divided into approximately 161 LATAs. The Bell Operating Companies (BOCs) provide Intra-LATA services.

**Local Exchange Carrier (LEC):** The local phone company which provides local (i.e., not long distance) transmission services. AKA "telco". LECs provide T1 or FT1 access to LDCs (unless the T1 circuit is completely intra-LATA). Inter-LATA T1 circuits are made up of a combination of Access and Long Haul facilities.

**Local Management Interface (LMI):** A specification for frame relay equipment that defines status information exchange.

**Local Loop:** A transmission path, typically twisted-pair wire, between an individual subscriber and the nearest public telecommunications network switching center. The wires provide ISDN service, but require an NT1 at the user end and an LT at the network end. (AKA, "loop" or "subscriber loop".)

**Logical Link Control (LLC2):** In a local area network, the protocol that governs the exchange of transmission frames between data stations independently of how the transmission medium is shared. The LLC2 protocol was developed by the IEEE 802 committee and is common to all LAN standards.

**Logical Unit (LU):** A type of network accessible unit that enables end users to gain access to network resources and communicate with each other.

**Long Haul:** The T1 element that connects to the Access portion of the long distance company's (LDC's) central office. The LDC is commonly called the point of presence (POP). Each LDC has a number of POPs, located throughout the country. The LDC is also called an IEC (Inter Exchange Carrier).

**Long Haul Communications:** The type of phone call reaching outside of a local exchange (LE).

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## M

**Management Information Base (MIB):** A database of network management information used by the Common Management Information Protocol (CMIP) and the Simple Network Management Protocol (SNMP).

**Megacom:** An AT&T service with a normal WATS line (typically T1) between the customer premise and the AT&T serving class 4 CO are the customer's responsibility.

**MegaLink:** BellSouth's leased T1 service.

**Message:** Associated with such terms as packet, frame, and segment. 1. In information theory, an ordered series of characters intended to convey information. 2. An assembly of characters and sometimes control codes that is transferred as an entry from an originator to one or more recipients.

**Modem:** A communications device that enables a computer to transmit information over a phone line. It converts the computer's digital signals into analog signals to send over a phone line and converts them back to digital signals at the receiving end. Modems can be internal and fit into an expansion slot, or external and connect to a serial port.

**Multiplexer (Mux):** 1. A device that takes several input signals and combines them into a single output signal in such a manner that each of the input signals can be recovered. 2. A device capable of interleaving the events of two or more activities or capable of distributing the events of an interleaved sequence to the respective activities. 3. Putting multiple signals on a single channel.

**Multiprotocol:** A device that can interoperate with devices utilizing different network protocols.

**RASFinder:** A secure gateway that provides multiple LAN users with high performance Internet access by functioning as a TCP/IP RASFinder that resides on the outer edge of a firewall.

**Multithreading:** The ability of a software system to be able to handle more than one transaction concurrently. This is contrasted to the case where a single transaction is accepted and completely processed before the next transaction processing is started.

## N

**Nailed Connection:** A permanent or dedicated circuit of a previously switched circuit or circuits.

**Nailed-up Circuit:** A semi-permanent circuit established through a circuit-switching facility for point-to-point connectivity.

**NAK (Negative Acknowledgment):** Communications code used to indicate that a message was not properly received, or that a terminal does not wish to transmit. Contrast with ACK.

**Network:** A group of computers connected by cables or other means and using software that enables them to share equipment, such as printers and disk drives to exchange information.

**Node:** Any point within a network which has been assigned an address.

## O

**Object-Oriented:** A method for structuring programs as hierarchically organized classes describing the data and operations of objects that may interact with other objects.

**Office Channel Unit - Data Port (OCU-DP):** The CO channel bank used as the interface between the customer's DSU and the channel bank.

**Off-hook:** The condition of a device which has accessed a phone line (with or without using the line). In modem use, this is equivalent to a phone handset being picked up. Dialing and transmission are allowed, but incoming calls are not answered. Contrast "on-hook".

**Off Premise Extension (OPX):** An extension or phone that terminates in a location other than that of the PBX. Commonly used to provide a corporate member with an extension of the PBX at home.

**Ones Density:** the measure of the number of logical 1s on a T1 line compared to a given total number of bits on that line; used for timing information in data recovery in AMI and B8ZS.

**On-Hook:** The condition of a device which has not accessed a phone line. In modem use, this is equivalent to a telephone handset that has not been picked up. In other words, it can receive an incoming call. Contrast "off-hook".

**Open Shortest Path First (OSPF):** A hierarchical Interior Gateway Protocol (IGP) routing algorithm for IP that is a proposed standard for the Internet. OSPF incorporates least-cost routing, equal-cost routing, and load balancing.

**Outage:** The measure of the time during which a circuit is not available for use due to service interrupt. Outage is the complement of circuit "availability" (100% minus % available = % outage).

**Out-of-band:** Signaling that is separated from the channel carrying the information (e.g., the voice/data/video signal is separate from the carrier signal). Dialing and various other "supervisory" signals are included in the signaling element. Contrast "In-band" signaling.

**Out of Frame (OOF):** A T1 alarm condition that is logged on the loss of 2, 3 or 4 of 5 consecutive FT framing bits.

## P

**Packet:** 1. In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. The data, control signals and, possibly, error control information are arranged in a specific format. 2. Synonymous with data frame. 3. In TCP/IP, the unit of data passed across the interface between the Internet layer and the link layer. A packet includes an IP header and data. A packet can be a complete IP datagram or a fragment of an IP diagram. 4. In X.25, a data transmission information unit. A group of data and control characters, transferred as a unit, determined by the process of transmission. Commonly used data field lengths in packets are 128 or 256 bytes. 5. The field structure and format defined in the CCITT X.25 recommendation.

**Packet Assembler/Disassembler (PAD):** Used by devices to communicate over X.25 networks by building or stripping X.25 information on or from a packet.

**Packet Data:** The information format ("packetized") used for packet-mode calls.

**Packet Mode:** Refers to the switching of chunks of information for different users using statistical multiplexing to send them over the same transmission facility.

**Parity bit:** An extra bit attached to each byte of synchronous data used to detect errors in transmission.

**Permanent Virtual Circuit (PVC):** A connection between two endpoints dedicated to a single user. In ISDN, PVCs are established by network administration and are held for as long as the user subscribes to the service.

**Physical Unit (PU):** The component that manages and monitors the resources (such as attached links and adjacent link stations) associated with a node, as requested by an SSCP via an SSCP-PU session. An SSCP activates a session with the physical unit in order to indirectly manage, through the PU, resources of the node such as attached links. This term applies to type 2.0, type 4, and type 5 nodes only.

**Point of Presence (POP):** The central office's end points of the long distance carriers.

**Point-to-Point Protocol (PPP):** A protocol that lets a PC user access TCP/IP (Internet member) using an ISDN terminal adapter or a high-speed modem over a standard phone line.

**Port:** A location for input or output data exchange. Computers, muxes, etc. have ports for various purposes.

**Primary Rate Interface (PRI):** Used on ISDN. In North America, and Japan, PRI is one 64 Kbps D channel and 23 B channels. Elsewhere, it is one D channel and 30 B channels.

**Primitive:** An abstract representation of interaction across the access points indicating that information is being passed between the service user and the service provider. The OSI Reference Model defines four types of primitives: Request, Indication, Response and Confirm.

**Private Branch Exchange (PBX):** A phone exchange located on the customer's premises. The PBX provides a circuit switching facility for phone extension lines within the building, and access to the public phone network. See also "Exchange".

**PROM (Programmable Read Only Memory - pronounced "prom"):** A permanent memory chip that can be programmed or filled by the customer after by the manufacturer has set initial values. Contrast with ROM.

**Protocol:** 1. A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. 2. In Open Systems Interconnection architecture, a set of semantic and syntactic rules that determine the behavior of entities in the same layer in performing communication functions. 3. In SNA, the meanings of and the sequencing rules for requests and responses used for managing the network, transferring data, and synchronizing the states of network components. 4. Synonymous with line control discipline.

**PSTN (Public Switched Telephone Network):** A worldwide public voice telephone network that is used as a telecommunications medium for the transmission of voice, data and other information.

**Public Data Network (PDN):** A packet-switched network that is available to the public for individual ("subscriber") use. Typically, controlled by a government or a national monopoly.

**Public Switched Telephone Network (PSTN):** The group of circuit-switching voice carriers, which are commonly used as analog data communications services.

**Pulse Code Modulation (PCM):** 1. In data communication, variation of a digital signal to represent information; for example, by means of pulse amplitude modulation (PAM), pulse duration modulation (PDM), or pulse position modulation (PPM). 2. Transmissions of analog information in digital form through sampling and encoding the samples with a fixed number of bits.

**Pulse dialing:** One of two methods of dialing a telephone, usually associated with rotary-dial phones. Compare with "tone dialing".



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## Q

**Quantizing:** The process of analog-to-digital conversion by assigning a range, from the contiguous analog values, to a discrete number.

## R

**Random Access Memory (RAM):** A computer's primary workspace. All data must be stored in RAM (even for a short while), before software can use the processor to manipulate the data. Before a PC can do anything useful it must move programs from disk to RAM. When you turn it off, all information in RAM is lost.

**Rate Enforcement:** The concept in frame relay where frames sent faster than the CIR are to be carried only if the bandwidth is available, otherwise they are to be discarded. (The frame relay network assumes that anything exceeding the CIR is of low priority.) Rate enforcement makes sure that the network will not get so congested that it isn't able to meet the agreed on CIR.

**Recognized Private Operating Agency (RPOA):** A corporation, private or government-controlled, that provides telecommunications services. RPOAs, such as AT&T, participate as non-voting members in the CCITT.

**Red Alarm:** A T1 error condition generated when a local failure (e.g., loss of synchronization) exists for 2.5 seconds, causing a Carrier Group Alarm (CGA). See also "Blue Alarm" and "Yellow Alarm".

**Request for Comment (RFC):** A set of papers in which Internet standards (published and proposed), along with generally-accepted ideas, proposals, research results, etc. are published.

**Ring Down Box:** A device that emulates a CO by generating POTS calls for testing and product demos.

**Ring Down Circuit:** A tie line connecting phones where picking up one phone automatically rings another phone. A feature used for emergencies to alert the person at the other phone of the incoming call.

**RJ-11:** An industry standard interface used for connecting a telephone to a modular wall outlet; comes in 4-and 6-wire packages.

**RJ-45:** An 8-wire modular connector for voice and data circuits.

**Robbed Bit Signaling:** The popular T1 signaling mechanism where the A and B bits are sent by each side of the T1 termination and are "buried" in the voice data of each voice channel in the T1 circuit. Since the bits are "robbed" infrequently, voice quality remains relatively uncompromised. See "bit robbing". The robbed-bit signaling technique is used in D4 channel banks to convey signaling information. The eighth (least significant) bit of each of the 24 8-bit time slots is "robbed" every sixth frame to convey voice-related signaling information such as on-hook, off-hook, etc, for each channel.

**Router:** A device that connects two networks using the same networking protocol. It operates at the Network Layer (Layer 3) of the OSI model for forwarding decisions.

**Routing Information Protocol (RIP):** A distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

**RS232-C:** An EIA standard for a serial interface between computers and peripheral devices (modem, mouse, etc.). It uses a 25-pin DB-25, or a 9-pin DB-9 connector. The RS-232 standard defines the purposes, electrical characteristics and timing of the signals for each of the 25 lines.

**RS-422:** The EIA standard for a balanced interface with no accompanying physical connector. RS-422 products can use screw terminals, DB9, various DB25, and DB37 connectors.

**RS-530:** The EIA standard for the mechanical/electrical interface between DCEs and DTEs transmitting synchronous or asynchronous serial binary data. RS-530 provides for high data rates with the same connector used for RS-232; however, it is incompatible with RS-232.

## S

**Serial Port:** The connector on a PC used to attach serial devices (those that need to receive data one bit after another), such as a mouse, a printer or a modem. This consists of a 9- or 25-pin connector that sends data in sequence (bit by bit). Serial ports are referred to as "COMx" ports, where x is 1 to 4 (i.e., COM1 through COM4). A serial port contains a conversion chip called a "UART" which translates between internal parallel and external serial formats.

**Service:** The requirements offered by an RPOA to its customers to satisfy specific telecommunications needs.

**Severely Errored Seconds (SES):** Refers to a typical T1 error event where an error burst occurs (a short term, high bit-error rate that is self-clearing). Per the ITU-T (CCITT) G.821: any second in which the BER is less than  $1 \times 10^{-3}$ .

**Signaling:** The process of establishing, maintaining, accounting for, and terminating a connection between two endpoints (e.g., the user premises and the telco CO). Central office signals to the user premises can include ringing, dial tone, speech signals, etc. Signals from the user's telephone can include off-hook, dialing, speech to far-end party, and on-hook signals. In-band signaling techniques include pulse and tone dialing. With common channel signaling, information is carried out-of-band.

**Simple Network Management Protocol (SNMP):** TCP/IP protocol that allows network management.

**Simultaneous Voice Data (SVD):** A technology for letting a user send data via a modem, and use a handset to talk to another user at the same time over the same connection. The alternative, making a second call, can be expensive or even impossible. The uses for SVD are telecommuting, videoconferencing, distant learning, tech support, etc.

**Stop Bit:** One of the variables used for timing in asynchronous data transmission. Depending on the devices, each character may be trailed by 1, 1.5, or 2 stop bits.

**Superframe (D4):** A T1 transmission format that consists of 12 DS1 frames, or 2316 bits. A DS1 frame consists of 193 bit positions. A frame overhead bit is in the first position, and it is used for frame and signaling phase alignment only.

**Subscriber Loop:** See "Local loop".

**Switched 56:** A circuit-switched (full duplex digital synchronous data transmission) service that lets you dial a number and transmit data to it at 56K bps. It is a relatively low cost service, widely used in North America for telecommuting, videoconferencing and high speed data transfers. Many phone companies are (or will be) phasing out Switched 56 in favor of ISDN service.

**Switched Virtual Circuit (SVC):** A type of data transmission where the connection is maintained only until the call is cleared.

**Switched Line:** In communications, a physical channel established by dynamically connecting one or more discrete segments. This connection lasts for the duration of the call, after which each segment can be used as part of a different channel. Contrast with leased line.

**Switched Network:** A network in which a temporary connection is established from one point via one or more segments.

**Synchronous Data Link Control (SDLC):** A discipline conforming to subsets of the Advanced Data Communications Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex, or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop.

**Synchronous Transmission:** The transmission of data which involves sending a group of characters in a packet. This is a common method of transmission between computers on a network or between modems. One or more synchronous characters are transmitted to confirm clocking before each packet of data is transmitted. Compare to Asynchronous Transmission.

**Systems Network Architecture (SNA):** The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks.

## T

**Tariff:** The rate/availability schedule for telephone and ISDN services from a regulated service provider.

**TCP/IP:** A set of communication protocols that support peer-to-peer connectivity functions for both local and wide area networks.

**T Carrier:** The generic name for a digitally multiplexed carrier system. In the North American digital hierarchy, a T is used to designate a DS (digital signal) level hierarchy. Examples: T1 (DS1) is a 1.544 M bps 24-channel designation. In Europe, T1 is called E1. The T Carrier system was originally designed for transmitting digitized voice signals, but has since been adapted for digital data applications.

**T1:** A digital transmission link capable of 1.544M bps. T1 uses two pairs of normal UTP, and can handle 24 voice conversations, each digitized at 64K bps. T1 is a standard for digital transmission in the U.S., Canada, Japan and Hong Kong. T1 is the access method for high-speed services such as ATM, frame relay, and SMDS. See also T Carrier, T1 line and FT1.

**T1 Channel Tests:** A set of diagnostics that vary by carrier, used to verify a T1 channel operation. Can include Tone, Noise Level, Impulse Noise Level, Echo Cancelers, Gain, and Crosstalk testing.

**T1 Framing:** To digitize and encode analog voice signals requires 8000 samples per second (twice the highest voice frequency of 4000 Hz). Encoding in an 8-bit word provides the basic T1 block of 64K bps for voice transmission. This "Level 0 Signal, as its called, is represented by "DS-0", or Digital Signal at Level 0. 24 of these voice channels are combined into a serial bit stream (using TDM), on a frame-by-frame basis. A frame is a sample of all 24 channels; so adding in a framing bit gives a block of 193 bits (24x8+1=193). Frames are transmitted at 8000 per second (the required sample rate), creating a 1.544M (8000x193=1.544M) transmission rate.

**T1 Line:** A digital communications facility that functions as a 24-channel pathway for data or voice transmission. A T1 line is composed of two separate elements: the Access element and the Long Haul element.

**T1 Mux:** A device used to carry many sources of data on a T1 line. The T1 mux assigns each data source to distinct DS0 time slots within the T1 signal. Wide bandwidth signals take more than one time slot. Normal voice traffic or 56/64K bps data channels take one time slot. The T1 mux may use an internal or external T1 DSU; a "channel bank" device typically

uses an external T1 CSU.

**Transmission Control Protocol / Internet Program (TCP/IP):** A multi-layer set of protocols developed by the US Department of Defense to link dissimilar computers across dissimilar and unreliable LANs.

**Terminal:** The screen and keyboard device used in a mainframe environment for interactive data entry. Terminals have no "box", which is to say they have no file storage or processing capabilities.

**Terminal Adapter (TA):** An ISDN DTE device for connecting a non-ISDN terminal device to the ISDN network. Similar to a protocol converter or an interface converter, a TA connects a non-ISDN device between the R and S interfaces. Typically a PC card.

**Tie line:** A dedicated circuit linking two points without having to dial a phone number (i.e., the line may be accessed by lifting the telephone handset or by pushing a button).

**Time-Division Multiplexing (TDM):** Division of a transmission facility into two or more channels by allotting the common channel to several different information channels, one at a time.

**Time Slot:** One of 24 channels within a T1 line. Each channel has a 64K bps maximum bandwidth. "Time slot" implies the time division multiplexing organization of the T1 signal.

**Toll Call:** A call to a location outside of your local service area (i.e., a long distance call).

**Tone dialing:** One of two methods of dialing a telephone, usually associated with Touch-Tone® (push button) phones. Compare with pulse dialing.

**Topology:** Physical layout of network components (cables, stations, gateways, and hubs). Three basic interconnection topologies are star, ring, and bus networks.

**Transmission Control Protocol (TCP):** A communications protocol used in Internet and in any network that follows the US Department of Defense standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communications networks and in interconnected systems of such networks. It assumes that the Internet protocol is the underlying protocol.

**Transport Layer:** Layer 4 of the Open Systems Interconnection (OSI) model; provides reliable, end-to-end delivery of data, and detects transmission sequential errors.

**Transport Protocol Data Unit (TPDU):** A transport header, which is added to every message, contains destination and source addressing information that allows the end-to-end routing of messages in multi-layer NAC networks of high complexity. They are automatically added to messages as they enter the network and can be stripped off before being passed to the host or another device that does not support TPDU's.

**Trunk:** Transmission links that interconnect switching offices.

**TSR (terminate and stay resident):** A software program that remains active and in memory after its user interface is closed. Similar to a daemon in UNIX environments.

**Tunneling:** Encapsulation data in an IP packet for transport across the Internet.

**Twisted pair wiring:** A type of cabling with one or more pairs of insulated wires wrapped around each other. An inexpensive wiring method used for LAN and telephone applications, also called UTP wiring.

## U

**UART (Universal Asynchronous Receiver/Transmitter) (pronounced "you art"):** A chip that transmits and receives data on the serial port. It converts bytes into serial bits for transmission, and vice versa, and generates and strips the start and stop bits appended to each character.

**UNIX:** An operating system developed by Bell Laboratories that features multiprogramming in a multi-user environment.

**Unshielded Twisted Pair (UTP):** Telephone-type wiring. Transmission media for 10Base-T.

## V

**V.25bis:** An ITU-T standard for synchronous communications between a mainframe or host and a modem using HDLC or other character-oriented protocol.

**V.54:** The ITU-T standard for local and remote loopback tests in modems, DCEs and DTEs. The four basic tests are:

- local digital loopback (tests DTE send and receive circuits),
- local analog loopback (tests local modem operation),
- remote analog loopback (tests comm link to the remote modem), and
- remote digital loopback (tests remote modem operation).

**Virtual Circuit:** A logical connection. Used in packet switching wherein a logical connection is established between two devices at the start of transmission. All information packets follow the same route and arrive in sequence (but do not necessarily carry a complete address).

## W

**Wide Area Network (WAN):** 1. A network that provides communication services to a geographic area larger than that served by a local area network or a metropolitan area network, and that may use or provide public communication facilities.  
2. A data communications network designed to serve an area of hundreds or thousands of miles; for example, public and private packet-switching networks, and national telephone networks. Contrast with local area network (LAN).

**Wide Area Telecommunications Service (WATS):** A low-cost toll service offered by most long distance and local phone companies. Incoming (800 call service, or IN-WATS) and outgoing WATS are subscribed to separately, but over the same line.

## X

**X.25:** ITU-T's definition of a three-level packet-switching protocol to be used between packet-mode DTEs and network DCEs. X.25 corresponds with layer 3 of the 7-layer OSI model.

## Y

**Yellow Alarm:** An error indication sent by the T1 device when it has not gotten a receive signal, or cannot synchronize on the receive signal received. Contrast "Red Alarm" and "Blue Alarm".

## Z

**Zero Byte Time Slot Interchange (ZBTSI):** A method for allowing 64K bps unrestricted user data (allowing all 0s in the user data). An alternative to (but not as popular as) B8ZS.

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